THE

ELECTRICAL REVIEW.

VOL. LI. OCTOBER 10, 1902. No. 1,298.

"ELECTRICAL REVIEW."

Vol. LI.] CONTENTS: October 10, 1902. [No. 1,298.

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THE
UNIVERSAL ELECTRICAL DIRECTORY
1902 Edition
READY.
H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. *Established* 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKEAY, LONDON." Code, A B C.
Telephone No. 933 Holborn.
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TROLLEY CAR ACCIDENTS.

THE increasing frequency of electric tramcar accidents in various parts of the provinces is to be deplored, and calls for serious consideration. This is so not because of any possibility of the progress of electric tramway traction being impeded; the necessity for electric cars is too widely recognised and appreciated now, for confidence in this system of travel to be easily shaken, and nothing—not even the enthusiastic propositions and arguments and great ideas of automobilists—is likely to stop the equipment of thousands of miles more of trolley line, with here and there some sections of surface contacts, conduits, and perhaps other things. But the recent accidents are especially regrettable in that they were, or ought to have been, preventable. Pending the publication of the reports of the Board of Trade inquiries at Glasgow and Devonport, it is impossible to ascribe the actual cause or to justly allot blame in the matter, but it would seem that the brake equipments are less responsible than the human factor. Questions must necessarily arise as to how far the slipper brake is equal to the very exceptional conditions which are set up by a motorman, from some cause or other, allowing his car to get beyond control on a steep incline bottomed by an awkward curve. There could be few more favourable spots for disasters, and correspondingly stringent regulations and efficient apparatus must be adopted with a view to nullifying, or, at any rate, minimising the effects of human error.

It appears that on the occasion of one of the Devonport accidents—that of June 3rd, happily unattended by fatal injuries—the driver was teaching a "new hand" who improperly applied the brake and then released it suddenly, thus causing the car to attain so high a speed that it could not negotiate the curve, but overturned instead. The "new hand" here, seems to have been allowed too much latitude at this admittedly awkward part of the line. The accident of Saturday, September 27th, recorded briefly in our last issue, is thought by the chief constable and the Corporation electrical engineer to be due to the car running away "through the absence of sand to prevent the wheels from slipping." The verdict of the jury at the inquest blames the insufficient instruction and "ignorance" of the driver. It will be interesting to see what the Board of Trade Report (Major J. W. Pringle) has to say on these points.

Considering the enormous traffic carried over electric tramlines, the loss of life on English systems is small indeed, but every possible step should be taken to prevent even this loss. In this connection the contribution which we publish to-day from the pen of Mr. H. B. Phillimore, on "Tramcar Driving," will, we think, be read with interest by tramway managers and employés, as well as by those interested in car-building and electrical equipments.

We have become pretty well used to hearing of car disasters in the States, where there are from ten to fifteen

times as many miles of track as we have in these islands. Our New York namesake has recently been urging tramway organisations over there to do their level best to protect the public, before the Legislature comes along with imperative excessive action, as it is wont to do occasionally in such matters. This suggestion presumably refers to the inefficient brakes—and sometimes no brake at all, save the primitive hand appliance—adopted on too many American street car lines. Our contemporary says among other things :—

> The too frequent occurrence of accidents on electric roads has recently provoked some severe criticism of the trolley systems. However much this may be deserved, the blame should be put where it belongs, and not on the method of transportation. These alleged abuses are not due to the method of propelling the cars, but to the manner of operating the road. . . Such abuses as are charged can be corrected by legislation, but this ought not to be necessary, for legislative action may be carried too far and really injure the roads. All the necessary precautions for the protection of the public should be adopted by the managements of the roads on their own initiative, and the sooner this is realised the better.

In this country the Board of Trade is not lacking in the attention which it gives to the braking appliance question, and being in possession of a more or less intimate knowledge of the devices on the market, and their respective merits, it may be trusted to deal with the matter as the circumstances require. That some appliance more powerful, more certain, and especially more rapid in operation, than the hand-brake is indispensable, needs no demonstration, and the cost of providing such must not be allowed to delay its provision. For that matter it should not be forgotten that, apart from the actual personal injuries caused by these regrettable occurrences, considerable loss ensues to the tramways, both on the score of compensation to the victims, and by loss of traffic owing to the evil impression conveyed to the minds of would-be passengers; so that from every point of view, the use of efficient brakes is advantageous and urgently necessary.

The Difficulties of Students.

The article on this subject, which is concluded in this issue, will, we hope, be read with interest by both teachers and taught—to one or both of which categories every man who claims the title of engineer must belong—as setting forth the views of one of the younger members of the electrical engineering profession.

While we are pleased to afford "A Student" the opportunity of stating his case, we are by no means in agreement with all of his conclusions. In the first place, our contributor complains that students have to learn just what their teachers choose to teach them. In this we fail to see a "difficulty;" the very first lesson to be acquired—one of Nature's own—is the necessity of discipline and order, and how could these be attained if every student, following the dictates of his particular taste or fancy, were to choose his own subject of investigation? Experience is essential to indicate the best course of study and the best methods of pursuing it. An engineering training must cover many branches of knowledge if it is to be worthy of the name—preserve us from the man of one subject and one idea! Breadth of view, the ability to examine a question from many standpoints, can only be acquired by the study of many subjects. A more inappropriate example to the contrary could hardly have been chosen than that of the medical curriculum, with its excursions into botany, zoology, chemistry and physics, mechanics and dog-Latin—the last named the only worthless subject of them all.

By a curious inconsistency, the making of a joint is objected to, while the actual construction of a dynamo or other electrical apparatus is applauded! Yet how many engineers, after their college training, expect to wind armatures and build up commutators with their own hands? Or even to *see* these things done?

By all means let every electrical engineer in embryo acquire a sound knowledge of the construction of dynamos and alternators—the foundation of the industry—by working with them, testing them in various ways, preparing designs and drawings, &c., as is already done in our best colleges, and has been for many years past; the actual construction of such machines in our colleges, however, is not only useless, but impossible. Our "Student" admits that such a course would be expensive, and wealth is not the strongest point in our system of technical education; a vast increase in staff and equipment would be required to carry out the scheme. But the point is this—*no one wants newly-fledged dynamo designers* of this type. What our friend really asks for is *experience*, a thing which cannot be acquired in a college. The purpose of a real system of education is to train men to *think*, so that, when they have the opportunity of gaining experience (after they leave college), they will be able to take the fullest possible advantage of it. They must inevitably be content to spend a few years at least in subordinate positions—in point of fact, the great majority must spend their lives in such—and then will be their chance of obtaining experience, with the aid of their previous training in principles and common sense, which enables them to understand what they see, and to draw correct deductions therefrom.

The ability to "hunt up and adapt" recorded experience and facts is a priceless gift; but this cannot be taught—here, again, it is the fruit of experience.

Our contributor is critical of lecturers, and, we fear, with only too much reason; but we cannot admire his method of waiting till a lecture is nearly over without taking notes—in the hope that a sort of "essential extract" will be served up hot at the end of it, to save him trouble. Many lecturers, alas! merely waste their own time and that of their students by pouring out upon the latter a torrent of words and symbols without a moment's pause. A good lecturer proceeds *ever slowly—festina lente* might well be his motto. A moderate dose of knowledge, thoroughly driven home (but not by vain and endless repetitions) is worth a dozen harangues. Another point—the "lecturer," who literally *reads* his lecture, is drawing his salary on false pretences. He is worse than useless. On these points we are in hearty agreement with "A Student."

We sympathise with him also in his criticism of unpractical mathematical instruction. Of what use is the calculus to men who, in their third year, cannot tell whether the result of a simple practical problem is in pounds or poundals? And why are they taught to use those pedantic units—in the class-room? They merely lead to confusion. Not only is the case just quoted a fact, but at the same place—one of our best technical schools—the simplest practical problems in acceleration were insoluble to the majority, who could, however, differentiate and integrate book problems with facility. We do not for a moment decry the teaching of practical mathematics; it is the lack of this—the teaching of mere ornamental mathematical gymnastics—that we deplore. No wonder students learn to hate the name of mathematics when they are so misled.

In conclusion, let not "A Student" think that we wish to severely criticise his views. True, we are in many points at variance with him; but we, with him, seek only to promote the cause of real technical training.

Wages and Work.

"The employer must pay more wages, the employed must do more work." Thus a London daily gives forth the opinion of American labour experts who have been investigating conditions over here. There is some truth—a good deal of truth—in what the article urges, though it is more or less tinged with ignorance of the purchasing power of wages here as compared with America. That the working man of Britain does not do as much work as can justly be required of him, is, we think, a generally true statement. Thousands of men literally loaf along, doing a minimum of work. There can be no doubt that many employers could afford to increase wages very largely if they could get their men to do a decently fair day's work for the money. A fair day's work might very easily produce double, treble, and often quadruple, the present output, without overtaxing the worker. Any man could easily lay four times the bricks laid by a London bricklayer, for example, and numerous other examples might be given. There is no call for men to work themselves to death. Indeed, it is probable that far more working men die of sheer ennui than of overwork. It is small wonder they are so glad when the bell rings, for it is dull work loafing by order from the Union, when there is work to hand waiting. It is said that one never sees an old workman in America. Americans will have it that they have all "made their pile" and retired; but they cannot all have become millionaires, and it is to be feared that many of them have retired underground. In plain language, the American workman is worked to death young. We should like to suggest that some of our soundest and best employers should make the experiment of having civilised, clean and tidy workshops, and should refuse employment to any but a superior class of workmen, carefully eschewing that brand which out of an earnings of 45 or 50 shillings a week, sends home 15s. to the wife and six children, and squanders the remainder in drink. This type is common; why encourage it? Much of the article before us is of the overdrawn style, as though America were a Paradise, and had no slums and no badly-paid workers; whereas, perhaps, no such misery exists as can be found in American cities and in American coal mining districts. Good fortune is as widely and unequally distributed there as elsewhere. It is very doubtful if the American people as a mass are so particularly well off. A few trustmongers seem to hold the bulk, and the workers work long hours to manufacture a few rich men. It would be a good thing for the physical future of the people if the British worker did a little more and the American worked to live, and did not live simply to work.

Common-sense in Mathematical Teaching.

A lively discussion took place at one of the recent meetings of the British Association, when the combined Sections A and L (Mathematical and Physical Science and Educational Science) considered the B.A. Committee's report on the teaching of mathematics, together with a very similar report drawn up by a committee appointed by the Mathematical Association. In all fundamental matters these two reports are identical; they insist that radical changes must be made in methods of teaching and of examining, and they assert that the time is ripe for such changes. The changes they require are in the directions of simplicity and common sense, for they justly hold up to scorn the artificial difficulties, and the purely conventional methods of solving such difficulties, which reign in so many schoolrooms. For some curious reason, connected perhaps with attempts to standardise or systematise school routine and to make the examiner's post an easier one, many masters teach arithmetic, Euclid, or its substitute, and algebra, as three entirely separate subjects, as unrelated one to another as Greek, chemistry, and calisthenics; and they cultivate, or fail to suppress, among their pupils, a spirit according to which a boy is thought to be doing something almost dishonourable — akin to "cribbing"—if he proposes to solve a problem in one subject by methods belonging to another. For example, "prove that $(a+b)^2 = a^2 + 2ab + b^2$" is perfectly simple to understand by algebra; but the similar proposition in euclid, even apart from the complicated language in which it is expressed, is sufficiently obscure to disgust any lad of robust health who loves the playground—and it is not immoral to attract rather than to drive a boy to his studies.

Again, boys are taught to extract cube roots by arithmetical processes in a way that no self-respecting adult would adopt; a way that inculcates contempt for time and money (*i.e.*, the price of manuscript paper). On what ground, we wonder, are logarithmic tables so often put on the pedagogue's "Index"? The reports drawn up by the two committees mentioned above, accordingly argue in favour of utility in mathematical work, that problems shall be solved by the easiest and most direct methods, that actual measurements may be made, that arithmetical operations shall be shortened, and that the degree of accuracy possible of attainment in practice shall be recognised in schools by limiting calculations to a last significant figure. An instance of the absurdity to which the absolute accuracy of arithmetical calculation sometimes leads in everyday life, may occasionally be seen in analysts' reports, when a man returns the percentage of a certain ingredient in a particular material with a decimal of half-a-dozen figures, forgetting all the time that his analytical processes involve errors perhaps reaching to the first place on the right of the point.

It is a healthy sign of the times that our professors and examiners are so busy condemning and revising their methods; but it is not equally healthy to observe the attitude of the general public and our professional politicians. There is an "Education Bill" before the community which is being discussed by Tom, Dick, and Harry with appalling loquacity. We do not profess to be skilled in political matters, but so far as we have been able to understand the flood of oratory which is being poured out day after day, the majority of our speakers care very little whether the Bill, as it stands, or with the modifications they suggest incorporated into it, is likely to prove of benefit to the country at large by improving our faulty educational arrangements — arrangements they unite in admitting to be faulty. The Bill, each speaker seems to assert, will develop into a good Act or a bad Act, simply as its provisions help, or fail to help, every growing boy and girl to cry aloud, with bigotry and precision, the Shibboleths which distinguish, with microscopic differences, the beautiful creed of the speaker from the erroneous doctrines held and promulgated by all his friends and neighbours almost without exception.

Municipal Ownership: An American View.—Our New York namesake recently said:—"Probably there is no city of between 10,000 and 100,000 inhabitants which has not already undergone at least one period of agitation in favour of municipal ownership of electric lighting plants. Just why this particular business has been seized upon for the exploitation of socialistic theories is hard to find out. The majority of aldermen and councillors understand the grocery business, or think they do, and it would seem that this widespread, necessary and important branch of trade might claim their attention rather than electric lighting, which they know nothing about and which has the further disadvantage of being a business requiring very expert management."

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ELECTRO-METALLURGICAL PROBLEMS.—II.

By ALEC. A. BEADLE, A.I.E.E., F.C.S.

Lead.

Many minerals contain lead in more or less quantity, but by far the most important source of the metal is galena ($Pb_1 S$); next in importance come cerussite ($Pb\ CO_3$), and pyromorphite ($(3\ Pb_3\ P_2O_8) + Pb\ Cl_2$).

Galena is generally associated with quartz and calespar, and with small quantities of copper, bismuth, zinc, iron, antimony, and arsenic sulphides, and invariably contains some silver, and often gold.

The ordinary reduction of lead from galena is fairly simple in principle, involving but two operations—(1) roasting to convert part into sulphate and oxide, and leave a part unchanged; (2) heating without access of air, which causes the oxidised portion to react with the sulphide, forming sulphurous acid and metallic lead. The two operations are conducted in one reverberatory furnace, by first allowing the air free access to the charge, and then excluding it. It is also reduced by melting in a blast furnace with metallic iron, or with a charge which would otherwise yield iron.

The lead has now to be refined and softened by exposure to air in a refining furnace, whereby antimony, copper, iron, &c., and some of the lead are oxidised, together forming a dross, which is removed.

The extreme purity to which it is necessary to bring lead, in order to make it a really marketable product, however, renders the operations of smelting and refining very intricate. The finished product must contain considerably over 99 per cent. of lead, the impurities usually being traces of everything contained in the original minerals used.

The whole of the original silver and gold are contained in the smelted lead, and have to be extracted either by the Pattinson process, or by Parke's process. The former consists in melting the lead in pots, and allowing it to crystallise by cooling, the crystals of pure lead being removed, and the operation repeated through a series of pots. The argentiferous lead ultimately collected at one end of the series is cupelled for the silver. Parke's process consists in stirring the molten lead with molten zinc, and allowing the mixture to separate. The whole of the silver passes into the zinc, which is ultimately distilled in iron retorts, the noble metals being left in the residue from the distillation.

An electrolytic process to compete with these methods has to produce pure metallic lead and silver in a more direct way. The noble metals, and some of the impurities, being electro-negative to lead, might be removed first, the iron and copper being electro-positive, might remain unreduced.

Many suggestions, based upon widely different principles, have been made in this direction. The first type is that in which the ore is dissolved by partial or chloridising roasting and treatment with water, or a solution of an alkaline salt capable of forming a double salt with the lead. The solution is then electrolysed. Any such process, however, involves the difficulty of making a coherent deposit on the cathode, and no satisfactory method of so doing has yet been devised. Further suggestions have been made to use the galena as an anode in a soluble salt, such as the chloride or better nitrate of lead, or a plumbate of soda. In the former the lead is dissolved, and most of the sulphur left behind; in the latter most of the sulphur becomes oxidised, but the anodes crumble, and the lead is deposited as a sponge.

Lyte has suggested converting the lead into chloride, and then electrolysing the fused chloride, obtaining first the silver and then the lead. This suggestion is an important one, and the question of obtaining the lead and silver as fused chlorides is discussed later.

When fused lead chloride is electrolysed, any silver or gold present is practically all deposited with the first portions of the lead, the subsequent deposit consisting of pure lead. The chloride fuses very easily at 262° C., and does not volatilise until a higher temperature is reached, although it fumes when air is allowed free access to its molten surface. It is almost entirely dehydrated by heat, and can be contained in iron vessels which become coated with lead, and but slowly eaten away by reducing and alloying with the lead. Carbon anodes and iron cathodes answer, but, to avoid the production of lead "fume," a molten lead cathode serves best.

Several processes have been devised for the refining of lead by electrolysis in solution and in fused chloride. In the Keith process, which was used for some time in the United States, the crude lead is cast into plates which are used as anodes in an acetate solution; the anode slime containing arsenic, antimony, silver, gold, copper and iron, is treated for the recovery of the precious metals, and the spongy lead, which has been collected from the cathodes, is pressed into cakes and melted down; 8,000 amperes were used for the deposition of 68½ lbs. per hour. Tommasi replaces the acetate of lead by a double acetate of lead and an alkali metal. A weak point in these processes is, that spongy lead produces much dross in melting down, which dross has to be again reduced. Borchers has thus devised a process in which fused basic lead chloride is used, the melted lead running over a series of iron steps being used as the anode, and the pure lead is deposited on to an iron cathode. At moderately low current densities the bismuth remains insoluble, and the electro-positive metals are not deposited.

The electrolysis of fused salts presents several advantages; the voltage is low, conductivity of electrolyte low, current density extremely high, current efficiency under suitable conditions is good, and the lead can be cast directly into marketable ingots; moreover, it enables the precious metals to be separated before the reduction of the lead is started, so that this means of reduction seems to promise well, and the obtaining of chloride direct from the ore would seem to deserve the most attention.

TRAM CAR DRIVING.

By H. B. PHILLIMORE.

With the advance of electric trams we have had many examples of a car getting beyond the control of the driver, and accidents resulting of a more or less serious nature. Some have necessitated an official inquiry: in the majority of cases nothing more serious has occurred than a damaged panel, or a shock to the nerves of the passengers. But even these are of serious consequence, for our cars will not be a success or pay as they ought, unless we obtain the entire confidence of the public.

Probably in the future many of these accidents will be averted by our being able to give the driver more instantaneous command over his car.

Meanwhile, we must make the utmost of the means of control at present provided. This we are not doing so long as drivers are to be seen in some of our large towns who have to look at their controller, or who ring their gong with their right foot.

A great deal could be done towards ensuring public safety by more careful training and more efficient supervision than prevails in some places.

And there is another direction in which more trouble might be expended; namely, in the designing of the front platform, and in the arrangement of the various means provided for controlling the car. There are usually six handles and pedals to be manipulated:—

1. Controller handle for regulating power.
2. Emergency brake and reversing lever.
3. Gong pedal.
4. Hand-brake lever.
5. Hand-brake ratchet pawl.
6. Sandbox pedal or pedals.

These are arranged to be worked as follows:—

1. By the left hand.
3. By the left foot.
4. By the right hand.
5. By the toe of right foot.
6. By the heel of right foot.

No. 2 is worked by the left hand for reversing, and the right for the emergency brake.

The various duties are distributed in this way, because it is of the utmost importance that it should be possible to perform more than one operation at the same time.

Thus, in the event of a foot passenger not noticing the approach of a car and stepping suddenly in front of it, the driver wants to cut off current, ring the bell, apply the handbrake, and, perhaps, sand the track, and they must all be done instantly. For, suppose it took the driver one second to cut off current before he can ring his bell, and one second to ring his bell before he can apply his brake, and suppose the car to be travelling 12 miles an hour, then the car will have travelled six yards before retardation commences, and those two seconds may mean much to the future life of the pedestrian.

A driver who can retard and accelerate the speed of his car quickly can, with equal safety to the public, do quicker time through traffic than one who is less expert.

But there have been cars built in which it is quite impossible to stand in such a position that all the necessary operations can be carried out at one and the same time.

The driver must have one hand on his controller and one on his hand-brake lever.

The left heel should be on the floor of the platform, and the toes on the gong pedal. The gong is sounded by raising the toes and then depressing them again.

The right foot should be so placed that the toe touches the pawl of the ratchet, and the heel is at the side of the sand pedal, so that it can be quickly raised and brought down again on a sand pedal. It should be possible to keep the sand pedal depressed with the heel while the toe is pressing the pawl into place.

The hand-brake lever should be able to make a revolution without touching the ribs of the driver when he stands with his feet in the necessary positions.

Great care should be taken that a man can comfortably stand in the position indicated, and have instantaneous control over each of the levers and pedals. The best arrangement can be got by trial, and that should be adhered to on all cars.

It then remains for the eventual proprietors of the cars to train and pick their drivers carefully, and for the driver to carry out instructions, drive with care, and keep cool.

Prompt manipulation of his somewhat complicated means of control is only to be obtained at the cost of considerable practice. A man may know everything about the mechanism of a car, but let some unforeseen complication arise in the traffic, and, without practice, he will be unable to apply his knowledge in the fraction of a second which may just avert disaster.

A driver must be able to control his car without having to think what actions he has to go through, just as he walks without thinking which foot has to be moved next.

The exact actions become more or less reflex, with the consequent advantage that they approach as nearly as possible to being instantaneous.

Take the case of a racing cyclist. There was a day when he could not even balance his bicycle. First he had to learn to ride at all; while he could still ride only slowly, he had to learn to steer, and then to use different muscles at different positions of his feet, so as to get as uniform a turning effort as possible. In a race he never thinks of these things. The whole energy of his brain is concentrated on the race itself. To pass an opponent he has to alter his direction several times, each time necessitating a fresh balance of his body, and he must pedal his very hardest. But in the race these actions are all done with no tax on his brain. He considers it time to pass and he passes. Had it been necessary for him to use his brain to think what to do, he could not so accurately have gauged the exact fraction of a second in which to pass his opponent.

So with our car driver. In case of emergency, he should be able to stop, slow down, or accelerate his speed without any tax on his brain due to minor details. The whole energy of his brain can then be absorbed in observing the conditions of the traffic and other affairs outside his car which demand his attention. There would be no reply then at an inquiry into a collision to a question as to the exact distance of the other vehicle. "I cannot say exactly. I was putting on my brake at the time."

Drivers should get practice in making emergency stops. If they are taught by being sent out on cars on service during the day time, then they should have one or two nights on a special car learning to use their brakes and to make the most of them at speeds that would not be permissible in the traffic. Make him drive first from one pole to another with his controller full over and then see how soon he can stop, ringing his bell at the same time. Then do the same yourself, and show him that by your greater experience you can stop the car in a much shorter distance. Show him where you think he made mistakes, and let him try again. Then take him to a hill which has a straight length at the bottom with no turn-outs, and give him practice in stopping at as high speeds as possible. If this part of his education is omitted we may get the following case.

A man has learnt in traffic, he is a careful driver, and his car has never travelled over 12 or 15 miles an hour, and has always been under easy control. A day comes, he is starting down a steep hill using his electric brake. One of the controller contacts has been damaged, and before he realises it the speed has increased to the greatest he has ever driven at, and is increasing every second. He has never before driven down that hill at more than 8 miles an hour. By the time he has got his hand brake blocks against the wheels the car is going 20 miles an hour. The feel of his brake is different to anything he has ever felt before, it does not seem to be having any effect, because he is unable to appreciate the difference between 20 miles an hour and 18 miles an hour.

Under these circumstances can we be surprised if he loses his head?

A man who had had practice in making stops at that speed would have no cause for losing his head. He would know the strength that would make the brakes most effective, and he would be able to recognise when the car was beginning to slow down, and would be perfectly confident that he could stop.

Teach the drivers all you can about driving, and try to leave them nothing to find out themselves. Institute a system of driving, and make them stick to it. If not taught, they find out little dodges themselves, and they show some of them to others, and you are apt to get several different methods amongst them all, which makes it harder for you to pick out the drivers who have the best control.

One portion of the equipment of some cars demands a few words—the track brake. This is worked by a wheel on the platform, which turns a screw. The screw enables great force to be applied, and does away with the need of a ratchet. But it takes a long time to move the blocks down to the rails. It cannot be brought quickly into action as the ordinary hand-brake can. It is, therefore, no use as an emergency brake. Also most of the track-brakes used in this country will not stop a car on a steep hill. The track-brake should be applied at the top of the steep hills, and left alone till the bottom is reached. Stops and starts are made with the hand-brake and controller, and the track-brake simply makes driving down a hill as easy as driving on the level.

THE DIFFICULTIES THAT STUDENTS OF ELECTRICAL ENGINEERING MEET WITH.

By A STUDENT.

(*Concluded from page* 574.)

This difficulty of bridging across the gap between theory and practice is, in many cases, greatly enhanced by the fact that these two parts of the student's training are carried on in probably two quite different places.

Take, for example, a technical college which gives its students a year or two's theoretical training, and then sends them out to a firm to go through the shops. While at the college the student very often in the course of his work would like some practical point explained, but has to wait until that part of his course is over. He then learns his manual work, and as he sees machines being built, he is continually noticing, if he be observant, details and problems in their construction which require a theoretical explanation. His theoretical course being, however, over, he is very often unable to solve these problems, since the actual workmen, as

a rule, know little or nothing about the principles which underlie their work. This seems to be a very weak link in any course of instruction, for if any course is to be thorough, every difficulty which crops up should be immediately made clear to the student, so that, as far as he goes, at any rate, his knowledge will be thoroughly sound, and he will feel confident that he has missed or slurred over no important point.

Drawing a conclusion from these points, it seems to me, in my humble opinion as a student, that the training of students should, in all cases, be carried out under a principal who is himself a thoroughly practical engineer,—a man who, while he excels in pure theory, should have himself been through the "shops," and most important of all, a man who thoroughly understands the design of electrical machinery in every detail, both theoretical and practical. The college itself should have, as far as possible, a workshop, however small, which is equipped to carry out the construction *throughout* of at least some small type of dynamo, motor, or transformer. The students, while at the college, should, after they have been taught sufficient theory to understand the principles of design, be made to design and construct throughout small electrical apparatus of up-to-date patterns. Each individual student should be made himself to design a small dynamo or motor to fulfil given conditions as to speed, output, efficiency, &c., being supplied with all reasonable knowledge gained by past experience, such as would be available in any drawing office.

He should be shown how to hunt up and adapt this previous knowledge to the particular case in question.

At the same time, however, care should be taken not to check any originality on the part of any student. Let each student as far as possible design his own machine throughout from the commencement, and he will take great pride in trying to make a thoroughly neat, ingenious and efficient article. Never mind if there are inherent faults in the machine—these will soon be found out by the student in the construction and testing of the machine afterwards, and when a student finds out in this manner that he has made an error in design or draughtsmanship, it will impress itself on him in a far more thorough and lasting manner than if merely pointed out to him on a piece of paper. Indeed, far more useful experience may be gained from constructing a faulty machine than a correct one, and the mistakes made will be most carefully avoided in the future.

It seems to me that this design and construction throughout by each individual student of at least one piece of electrical machinery is most important. Every calculation, every drawing, every detail of manufacture will be performed with additional interest and care, and the efficiency tests afterwards will be gone through with the greatest interest instead of in a haphazard and careless fashion.

Competition, too, will reign keenly among the students, and think of the value of the possession of a set of drawings and calculations throughout.

It may be urged that the expense is too great, but surely the interest in work and the thoroughness of such a training would more than repay it, and the student once shown how to design, will in his own spare time be continually striving to design better apparatus and improve on details of construction.

I still have one or two points to touch on.

One is this—the method of lecturing. All lecturers have their own special method, and the student has one minute to listen to one type of lecturer and the next to listen to quite a different type. The method of taking notes has to be suited to each individual lecturer, and consequently there are often very important notes lost.

To explain—one lecturer will talk for half an hour and then at the end sum up the pith of his lecture and give it out slowly so that it may be copied into note books almost *verbatim*.

The next lecturer may start in the same manner, the students wait to the end to take notes, and then find that this new lecturer does not sum up his remarks, and consequently no notes are taken of the lecture at all, and much is forgotten. This appears a point which could be so easily remedied, and with such beneficial results. The main points of every lecture should be given out slowly either at the commencement or at the end of each lecture, so that they can be entered with reasonable care and neatness into rough note books. The system once chosen should, however, be strictly adhered to, as a sudden change without any warning would mean the loss of a whole lecture's notes.

Another point is the symbols used in various subjects. It not infrequently happens that two professors are teaching the same subject, or, at least, parts of the same subject to the same class, and each professor uses his own particular symbols with the result—dire confusions, and hours of time spent of an evening trying to disentangle θ's and ϕ's. A uniform system of symbols and abbreviations should be used by every lecturer in the college, and it is my belief that a small card with symbols and their explanations printed on it should be supplied to every student on entering a college. This would avoid all doubt and ambiguity once and for all. While on the subject of lectures, there is one class of lecturer, and a very common one too, who, in the name of my fellow students, I must strongly protest against. This is the man who is always in a hurry, who has so much to say on the subject that he cannot get it out fast enough. This sort of lecturer is worse than useless. It is mere waste of time for the students who, for an hour or two, are so confused that they literally don't know where they are, and leave the class room with such a confused "jumble" in their heads that they are not fit to attend another lecture for hours.

Do let me remind you lecturers, one and all, that we students are not so clever as you. It seems to me that it is not altogether the cleverest man, and the man who can write a long string of letters after his name, who is best fitted to teach; in fact, the reverse is often the case. Undoubtedly the big man, with a long tail to his name, is useful on the first page of a college prospectus; but, being so great and clever himself, he very often cannot understand the simple difficulties that form a stumbling block to the student. It is very often the man who is himself not so exceptionally gifted who is the best help to the student. He has himself experienced just the same difficulties as the average student; has had to climb laboriously over the same stumbling blocks, and is therefore in a better position to appreciate and understand the humble difficulties of the student.

The last point that I wish to touch on is a point which has, perhaps, not hitherto been discussed, and it is the commercial training of the engineer.

A short time ago I heard a discussion in a private committee room of the House of Commons on the suitability of a site for some gas works. The principal witnesses on either side were expert engineers, and the amount and variety of knowledge entirely apart from their profession which they had to show was enormous. The value of building land, of dwelling houses, the laws of compensation for property taken or damaged, and such like things too numerous to mention, they were expected to have at their fingers' ends.

To expect a student to learn all this in his course of study is too much, but I believe that a short and practical insight into the very necessary commercial branch of his profession should be most certainly given him.

He should at least know the essential principles which constitute efficiency and economy in manufacture and works management, a little about some system of standardisation in manufacture so as to enable a large number of machines of the same class to be manufactured cheaply and quickly, a little about the law governing the relations between the employer and his workmen, and also a few gleanings from the patent laws so as to be able to protect himself in any eventuality.

Summing up all the points I have touched on in this little article, I will simply say that, taking everything into consideration, it is my belief, and the belief of every thinking student that I have come across, that the present system of training of electrical engineers fails, firstly, because of the lack of continuity in training as regards theory and practice; and, secondly, that the heads and staff of many of our Institutions are not practical enough. It is thought that if a student is turned out with his head full of $dx\,dy$, and with excellent certificates, that they have done their duty, but the unfortunate student though thus provided with excellent tools has never been taught how to use them to his best advantage.

There are many things that go to make the qualifications of a successful engineer, but the chief one is that he should

be able to turn what knowledge he has, however little it may be, to the best practical account; that what theory he does know, the more the better, of course, should be at his fingers' ends and ready for immediate use; in other words, that he should be practical, in the real meaning of the word, to his finger tips.

I must now conclude, as I am afraid that it is too much for a student to presume to take up any more of valuable space in a professional paper. Perhaps, indeed, this little article may never be allowed to see the light of day, but I hope Mr. Editor will remember that he was a student himself once, and will not be too hard.

My readers must bear in mind that these are but the views of a student, but, at the same time, they are the outcome of his training, and, if wrong, point to a flaw somewhere in it.

It is quite possible that many students—possibly all professors—will disagree with what I have said. I shall not mind this; better to have wrong views than no views at all; and my object is simply, if possible, to promote some discussion on the subject and set those in authority thinking.

If, at the same time, I have been allowed through the courtesy of the Editor to have shown up any real difficulties that my fellow-students experience in fitting themselves for their profession, I shall feel more than repaid for the trouble I have taken and the possible adverse criticism that my views may be subjected to.

PROCEDURE ON APPLICATION FOR A TRAMWAY ORDER.

[BY A LEGAL CONTRIBUTOR.]

(*Continued from page* 535.)

AT the conclusion of our previous article we pointed out that if the proposed tram lines of the promoters cross any railway or canal, due notice must be given on December 15th to the railway or canal company.

A notice of this kind must state that every company, corporation or person desirous of making any representation to the Board of Trade, or of bringing before them any objection respecting the application, may do so by letter addressed to the Assistant Secretary of the Railway Department of the Board of Trade, on or before the 15th January then next ensuing; that copies of their objections must at the same time be sent to the promoters, and that in forwarding to the Board of Trade such objections, the objectors or their agents should state that a copy of the same has been sent to the promoters or their agents.

Notices to Frontagers.—In view of the fact that frontagers are generally conceded a *locus standi* to oppose a tramway undertaking, they are entitled to notice of an intended application to Parliament on the part of a tramway company. On or before the 15th of December immediately preceding the application for a provisional order, notice in writing must be given to the owners, lessees or reputed lessees, and occupiers of any street or road where, for a distance of 30 ft. or upwards, it is proposed that a less space than 9 ft. 6 in. shall intervene between the outside of the footpath on either side of the road and the nearest rail of the tramway. This rule applies to premises on both sides of the road, and the notice must contain an intimation to each frontager to the effect that if he has any objection, the same must be made before January 1st to the assistant secretary of the Railway Department of the Board of Trade, and that a copy of his dissent must be supplied to the promoters.

A few words may here be said as to the *locus standi* of frontagers. As we have seen, those whose premises abut on the street in which the tramway is to be laid are usually allowed to be heard; but the term "frontager" is not limited to such persons. Thus a *locus standi* was allowed to persons as frontagers whose premises were in a side street and separated from the line of route by a railway bridge.* So also the lessees of a market abutting on the side of the proposed route;* and the owners of a mews opening on to the road.†

These cases do not imply that the various owners who are therein described as "frontagers" are entitled to the notices to which allusion as been made.

Deposit of Documents.—The next matter to which the attention of the promoters should be directed is the deposit of necessary documents. There must be deposited on or before December 23rd, at the office of the Board of Trade—

1. A memorial signed by the promoters, headed with a short title descriptive of the undertaking (corresponding with that at the head of the advertisement), addressed to the Board of Trade and praying for a provisional order.

2. A printed draft of the provisional order as proposed by the promoters, with any schedule referred to therein.

3. An estimate of the expense of the proposed works, if any, signed by the persons making the same.

The promoters must also deposit a sufficient number of such printed copies at the office named in their behalf in the advertisement; such copies to be there furnished to all persons applying for them, at the price of not more than 1s. each.

The plans above referred to must indicate the exact position of the proposed tramway in every street through which the same is to pass. The gradients are to be shown on sections supplied with the plans.

List of Railways, &c., Local Authorities, &c., and Frontagers Interfered with by the Promoters.—On or before December 23rd there must be deposited at the Board of Trade—(*a*) lists of railways, tramways and canals crossed or otherwise affected or interfered with; (*b*) lists of the local and road authorities and who are to be interfered with, and a copy of the notice served upon them; (*c*) copy of the street notice; (*d*) a list of the frontagers and a copy of the notice served upon them; (*d*) a description of the land (if any) which the promoters purpose to purchase for the construction of the tramway; (*e*) a list of every provisional order or Act of Parliament (if any) of the promoters; and where the promoters are a company incorporated under the Companies Act, 1862, a printed copy of the memorandum of association, articles of association, and any registered special resolution of the company, and in the case of a company incorporated in any other manner, a copy of every deed or instrument of settlement or incorporation; (*f*) a fee of £35, by cheque, payable to "an assistant secretary of the Board of Trade." (This fee will not necessarily be taken to cover the cost of inquiries in other matters arising out of the application. With respect to costs in such matters, security must be given from time to time as the Board of Trade may require.)

Requirements of the Standing Orders with Regard to the Deposit of Plans, &c.—Rule XIV. of the Board of Trade rules relating to applications for provisional orders require that the "Standing Orders" of both Houses of Parliament must be observed by the promoters. It is provided that whenever plans, sections, books of reference, or maps are deposited in the case of an application to any public department or County Council for a provisional order or certificate, duplicates of the said documents shall at the same time be deposited in the office of the Clerk of the Parliaments, provided that, with regard to such deposits as are so made at any public department, or with any County Council, after the prorogation of Parliament, and before the 30th day of November in any year, such duplicates shall be so deposited on or before the 30th day of November.

Consideration of Application by the Board of Trade.—Sec. 7. On receipt of any application, the Board of Trade may, if they think fit, direct an inquiry in the district to which the same relates, or may otherwise inquire as to the propriety of proceeding upon such application, and they shall consider any objection thereto that may be lodged with them on or before such day, as they from time to time appoint, and must determine whether or not the promoters may proceed with the application. An inquiry, which is in the nature of an arbitration, is held by a referee specially appointed. It is held in accordance with the provisions of Sec. 63 of the Act of 1870.

* Brentford and District Tramways Bill, Rickards and M., 8.

* North Metropolitan Tramways Bill, Rickards and M., 122.
† *Ib.*, p. 125.

Where it appears to the Board of Trade proper that the application shall be granted, with or without addition, modification, restriction, or condition, they may settle and make a provisional order accordingly, subject to certain provisions and limitations which are contained in Secs. 8, 9 and 10 of the Act of 1870.

Other Rules to be Observed.—On or before the 15th of January an agent must be prepared to prove compliance with the provisions of the Act and the rules, and he must complete such proof on or before the 22nd of February; on or before the 8th of February any local or road authority desiring to have amendments inserted in the order must deliver same to agents for the promoters, and to the Board of Trade.

On or before the 22nd of February agents must deposit at the Board of Trade the draft printed order, containing in manuscript the amendments agreed upon, and showing, as far as possible, the other amendments.

After the 22nd of February no proposals for clauses, &c., will be entertained by the Board or Trade.

Payment of Deposit.—When the order has been finally settled, and before it is delivered to the promoters, they are to pay the deposit, not to be less than £4 per cent. on the estimated cost, into the prescribed bank.

Confirmation of the Order.—When the order has been made and before it is introduced into the Confirmation Bill, the necessary proofs of deposit and advertisement must be submitted to the Board of Trade. It is provided by Sec. 14 that these must be forthcoming not later than April 25th. When every requirement has been observed and the order settled and delivered to the promoters and duly published, the Board of Trade, as soon as can be after the expiration of seven days, must procure a Bill to be introduced in relation to any provisional orders so published not later than April 25th in any year, for an Act to confirm the provisional order. Until such confirmation, with or without amendment, a provisional order has no operation.

While any such Bill is pending, a petition may be presented against the provisional order, and if so the Bill may be referred to a Select Committee, when the petitioner may be allowed to appear and oppose. The costs of and connected with the preparation and making of each provisional order are to be paid by the promoters.

(To be continued.)

CORRESPONDENCE.

Mechanical Engineers for Electric Generating Stations.

I have been somewhat amused by the correspondence on the above subject, but fear that I am not able to follow the arguments.

I was for some three years assistant engineer in the stations of one of the largest London supply companies, and I am not able to recognise the post of station superintendent. We had resident engineers and assistants, the latter each taking a shift, and as these shifts varied week by week so the duties varied; that is, normally by day maintenance, and by night the load to look after, and there was no need of a superintendent, the assistant on duty having to run the boiler house, engine room and switchboard as far as superintendence was concerned. Therefore, I fear I do not realise Mr. Vezey's shift engineers, but neither do I realise the duties he says they ought to be able to perform.

I think I can take indicator diagrams with the best, but I have never had to do so, and as far as I am aware, except on one occasion, no one ever did. Our reports told us all we had time to want to know, and if we saw the water or coal per unit getting up we routed out the cause, but with a regular system of overhaul 99 stations out of 100 never need Mr. Vezey's tests, and the only time anyone tried taking consumption tests when I was on duty they promptly made the stokers drop steam and got fired out of the boiler house; it must be a quite Utopian station where a perfect system of steam trials can be regularly carried out without upsetting the general running of the station.

I cannot help wondering what sort of station Mr. Vezey has had his experience in, as I feel sure no company would allow the profitless steam consumption necessitated by regular steaming trials, and if it was under a municipality it only proves what has been said lately in the Press about the immorality of that sort of control, when it allows the ratepayers' money to be wasted by people like Mr. Vezey, who could find out all they want to know by a proper system of weekly station reports, and yet, for their own amusement, take tests on machinery, under what are not actual running conditions, that are, therefore, practically valueless.

In conclusion, I may say that, as far as my experience goes—and at the present moment I am assistant to a consulting engineer with something like 30 supply stations under his control—the assistant station engineers run the stations, the residents, or managers, having more in other branches than they can manage, without attempting more than a general supervision.

A.I.E.E.

Mr. Vezey's last letter on this subject reminds me of the following story:—A gentleman was once travelling in Italy, and happening to glance out of his carriage window he saw a woman with red hair. He thereupon promptly pulled out his diary and wrote therein: "All Italian women have red hair."

People like Mr. Vezey do an immense amount of harm by writing from narrow experiences. He informs the public that having had over 15 years of experience in practical, mechanical, and electrical engineering, and having held the post of station superintendent, any comment on his lack of experience is needless; but unfortunately for Mr. Vezey, he writes this truly amazing statement:—"The shift engineer, by the way, is *not allowed* to handle the engines." Lewis Carroll would have added: And the engines are not allowed to handle the shift engineer! One sentence contains as much sense as the other. And this from a man of 15 years' experience!

If Mr. Vezey be correct in his conclusions that the majority of shift engineers are quite incompetent and useless, the logical outcome would be that these gentlemen could be done away with in the majority of stations, and, oh! what a blessing that would prove to financial managers of certain towns. Here are three men whose added salary comes to, say, £300 per annum. Dismiss them and thus wipe out or translate to the profit column that horrid figure which now appears in the deficit column!

I have a certain respect for station superintendents (if they allow the shift engineers to handle the engines) and also for station fitters; but to read in cold type that these men run the station (as if keeping the plant in repair is all that is required for running the station), is romance of the basest sort. Mr. Vezey's letter clearly indicates that he has been so occupied in keeping his shift engineers from handling the engines that he has had no time to form a true or honest opinion of the competency of the majority of that hard-working and much-put-upon body of men.

A Shift Engineer.

I should like to give you an instance of the result of putting a mechanical engineer in charge of a station. They used to have two shift engineers—one electrical and one mechanical—at a certain large station. Then the post of electrical shift engineer was abolished, and the mechanical engineer was left in charge. One night a high-tension fuse on a substation main blew. Of course, the other subs. could have taken up the load of the disconnected station between them. However, the mechanical engineer shut down the whole central station for a time and left the town in darkness.

F. R. C. R.

London, N.W.

Electric Drills.

I shall esteem it a favour if any of your correspondents can give me information respecting electrically-driven drills for working in hard shaley clay.

F. H. Cooke.

Peterborough, *October 3rd*, 1902.

The Wolverhampton Surface Contact System.

We have been consulted by our clients, the Lorain Steel Co., with regard to the statement which appeared in your issue of the 19th ult., under the heading "Wolverhampton," to the effect that the Lorain Steel Co. have admitted their liability for the loss of a horse belonging to Mr. Gibbons killed on the tramlines in Piper's Row soon after their opening.

The statement referred to is untrue, as our clients have made no such admission, but on the contrary, have always disputed their liability on the ground that the horse was not killed by electric shock as was alleged. Our clients had ample evidence to have proved their contention, but in order to avoid expensive litigation, an arrangement was come to under which our clients paid to Mr. Gibbons less than half his claim on the distinct understanding that their liability was by such payment in no way admitted.

Inasmuch as the inaccurate statement complained of is calculated to damage our clients, we have to request that you will in your next issue publish a correction so as to accord with the real facts which we have in this letter made known to you.

A. J. Greenop & Co.

Bush Lane House, E.C.
October 2nd, 1902.

An Interesting Letter from Kumassi.

Herewith we enclose copy of a letter which we have recently received from his Excellency the Chief of Inkawie, which you may think of sufficient interest for insertion in your columns. After reading this, who can say that electricity is not becoming known in the uttermost parts of the earth? It is, at any rate, pleasing to see that our name has reached even the raw savage.

Veritys, Ltd.,
W. B. Shrimpton,
Export Department.

September 30th, 1902.

With the Chief of Inkawie's Compliment to Veritys, Ltd.

Kumassi, *August 22nd*, 1902.

Sirs,—It was in my mind to oblige you with the favour of my early reply in answer to your advertisement of late when it was handed with the thorough understanding to its contents. But the failure is from his Excellency the Chief of Inkawie's having made me to accompany one Capt. A—— to one of his lands Odumasi for the purpose of inspecting its boundary, as it seemed to be usurped by one Kwakye Inketia, the chief of Nkwanta: and upon a search being instituted, it was discovered that the judgment depends upon the returning of Capt. S——, who left the Gold Coast lately for Europe for the purpose of attending the assembly of his Majesty's coronation. As we hear. We have, therefore, returned from the bush again to Kumassi, and there have I taken the liberty of answering to your favour. I learned from yours that you have the pleasure of instructing me for the dispatch of catalogue; but sorry I have for some time expected to embrace its arrival with constantly attending the post office, and in all such struggles it cannot come. I cannot by that know what you have in store as to confirm the friendship by orders. This especially what I have expected to hand from you before reply the letter as I thought to do so at the same time with making orders of what I shall consider marketable in the said catalogue. I want to know with the Chief of Inkawie if you will like in Kumassi, as there will no longer be a place for the prosperity of merchants that we have a store built, and ask you to furnish us with goods to be stored and sell. Upon this do we wish to obtain a complete catalogue from you for ocular view. If the peace in Kumassi existed long, you will see what amount of interest you will obtain from the hand we are applying to the place. "Will you like concession afterwards?" Reply same.

The favour of your reply will oblige.

Faithfully yours,
(Signed) Charles E. Otoo,
Chief Correspondent to his Excellency the Chief of Inkawie.

"Sample of photo. camera required."

Bell Punches at Halifax.

In your issue of September 12th, 1902, I notice that bell punches have been given three months' trial, and that the manager found four advantages for and 22 against.

I should like to ask if these bell punches, which are used in London, Dublin, Bristol, and by the British Electric Traction Co. on all their tramways, are to be put on one side merely because it is a patent that does not work in a proper manner. I have had 12 years on tramways, and find the bell punch the best and safest, and not likely to register cash when none is taken. I, for one, as a ratepayer, think it is time that our tramways were under better control, and the sooner the better for us ratepayers.

One Who Knows.

A Question of Trade Etiquette.

I am requested by the Northern Section of the National Electrical Contractors' Association to write you with reference to the letters which have appeared on the above subject.

It is not clear if the contractors, whom your correspondents mention, had to take the responsibility of connecting up and starting the apparatus, but we gather from the letters that such was the case, and we consider that, in such case, the contractor was fully entitled to a discount for his trouble and responsibility in fixing and connecting up the motors.

Your editorial comment "apparently he" (the contractor) "must have mistaken fans for fittings," is not clear to us. What is the reference?

William Cross, *Hon. Sec.*

Newcastle, *October 7th*, 1902.

[We understand that electrical contractors object to direct dealings between manufacturers and purchasers who are not in the trade, and claim the sole right to supply "fittings." Hence we presume that if such are supplied to clients whose premises they are wiring, they claim a percentage from the agent or manufacturer who supplies the fittings. A fan can hardly be regarded as a fitting—hence our comment.—Eds. Elec. Rev.]

Humming in Pipes.

The humming might be due to the dynamo not generating a perfectly steady current, and also to the mains being run in separate steel conduits.

The current flowing along each main running through the two steel tubes would magnetise the steel tubes. Any variation in the current would alter the magnetisation of the tubes.

Owing to the commutator segments not being sufficiently numerous or else the brushes sparking, the current generated might have a rapid regular variation. This would cause a regular variation in the magnetisation of the steel tubes, and if sufficiently rapid might cause a hum.

If the two mains were run close together in one conduit, the current in the two mains would neutralise one another, and thus stop the hum.

The dynamo also might be looked to.

There would be no hum when running from battery direct, as in this case the current is perfectly steady.

H. B. P.

ORGANISATION OF AN INDUSTRIAL UNIT.

Without decent organisation, an industry cannot well prosper. Mr. Mullin, who writes on the subject in *Cassier's Magazine*, raises several points which are worthy of attention by men who are at the head of industrial concerns.

He compares our organised business to a chain of many unequal links, which does not lie straight between its two ends, so that a pull at either end, or on any one link, is not transmitted freely to all the other links. Do we not all know organisations where the expressed intention of the guiding mind travels only part way to those intended to receive it? Some individual link of the chain receives a pull from above, or from below, and fails to transmit, because it suits him not to do so, though he may be perfectly clear that he should do so in the general interest. Energy is dissipated at bends and at slack points. A high-class, well-balanced organisation should resemble a taut chain, so that any pull on any point of the chain will slightly distort the whole curve. May we not say that the chain should hang in a curve, and thus contain within itself the power of resuming its curve of stability as soon as the disturbing pull has ceased?

Self-acquired experience is more easy to utilise than the experience acquired by other minds. Thus it is, says the author, that a mind in charge of, say, a locomotive works, and trained in the boiler

department will tend to favour the boiler department, whereas a machine shop mind would lay stress on other parts. Heads of commercial undertakings need to guard themselves against this mental attitude. Non-technical minds will always tend to disparage the technical department. A familiar example amongst engineers is the North-Western Railway, of which it was once customary to say that it was better to enter the traffic department than the engineering, whereas on certain other lines the engineering department is found better.

When such predilections once obtain, they tend to accentuate the difficulty, and a neglected and despised department becomes a weak link in the chain. To this day evidence of this may be guessed from the abnormal and extravagant use of double-headers on the North-Western line, without any apparent benefit to speed or punctuality of running.

In a manufacturing establishment there is usually some weak link. Perhaps the head of some department is not successful in securing good appliances. It may be his own fault; it may be the fault of the general manager, who does not like the man. In either case the department suffers, and sometimes—nay, usually—the whole output of a works hangs back for the fault of this one department. Some works can sell more than they can make; others cannot sell their products. There is want of balance all round. The author's remarks on standardisation are good. Standardisation carried too far means death to progress. Do not standardise whole objects, but only parts.

Standardisation, as we all know, is a great help towards selling a standard article, or one made of more or less heterogeneous standard parts, is cheap to make, quick to deliver, and will often secure an order. Business men who are the first to blame engineers for lack of foresight, will put off the purchase of goods till the last minute, the want of which was plainly foreseen. As such goods cannot be made at once, the tendency is to order from the earliest promiser. Take the case of the Egyptian locomotives obtained from America at short notice. They proved to be dear at a gift as compared with the Belgian engines, and these in turn were found to cost much more than the initially more-costly British engines. But the American engines were in a sense bought off the shelf, owing to having been made standard.

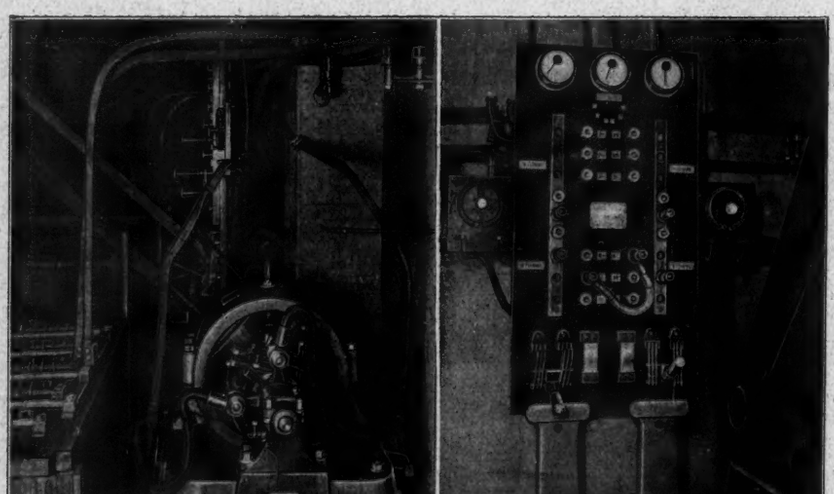
Now, there is always a tendency when cheapening production to carry economy into the materials and finish. English manufacturers who have been prevented from standardising by too severe and even foolish specifications, have, perhaps, gone too far in mere finish. Americans have gone too far in cheapness, and though they have snapped up orders on cheapness and delivery, have gained a bad name for poor work, and are likely to suffer in the future. As our author shows of one American works, there are so many standard details that a whole new locomotive is easily made up of these heterogeneous parts. Does not this account in some measure for the uncouth ugliness of the American locomotive? Other American productions do not appear so ugly, nor do such locomotives as are made entirely afresh, or largely so.

Standardisation is, after all, but a link in the whole chain, and no one link ought to be made too important. Take shop costs for example. Too developed a shop-cost system may entail, after a certain point, an expense greater than the loss entailed by a less perfect system. This is especially the case when the workmen themselves are made to do too much book-keeping. In all undertakings which we may copy from Nature and make our best institutions most highly organised, we must not forget the brain of the highest natural product. Man's brain is double: one part is automatic and keeps the heart at work, causes the lungs to breathe, and keeps the balance of the body in walking; the other brain works to order. If it were not for the automaticity of the brain a man might die of sheer absorption in work, for he would forget to keep his blood circulating. So in an industrial concern a great part of the guidance should be automatic. A new undertaking usually succeeds by the all-round knowledge of the founder, who has everything in his ken, and keeps his health until business is established. In time the business becomes automatic and runs easily. Later it fails because its links have deteriorated and the chain has slackened. In large undertakings such as railroads in this country, the whole business is a rank failure.

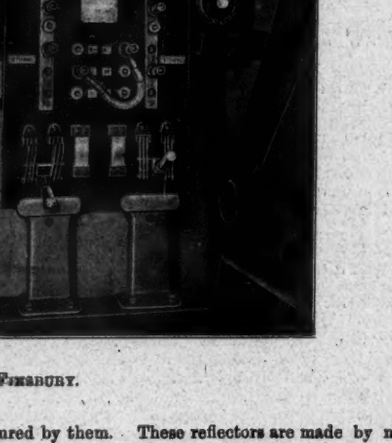
The directors are not usually men of special knowledge in railroad work, and in the working staff all promotion goes by mere seniority, and an outsider never gets employment. Hence systems and knowledge of details and ideas of methods are merely transmissions from the year 1829 or thereabouts of the thought and method of seniors to juniors. While good practice has been transmitted, so also has bad practice, and few railway men are original in ideas. If original they are too often wrong. If original and right they are disliked. Railroad officialism becomes as narrow and hide-bound as Governmental officialism. It is only where a reasonable influx of new blood is allowed that great undertakings are really successful through long years. Men who obtain positions by a sort of apostolic succession and retain them by mere inert good behaviour, are not usually of the sort to attempt anything outside the common rut.

COPPER DEPOSITING PLANT.

A large copper depositing plant has lately been erected at the British Luxfer Prism Syndicate's works, 16, Hill Street, Finsbury, for the purpose of forming the reflectors, or rather refractors, manufactured by them. These reflectors are made by mounting a series of prisms in light frames made of metal strip, and on the edges of these strips copper is deposited to form a beading which naturally adapts itself to the shape of the edges of the glass prisms, and holds them rigidly in place. The complete reflector is shown in one of the accompanying figures, and is becoming a familiar



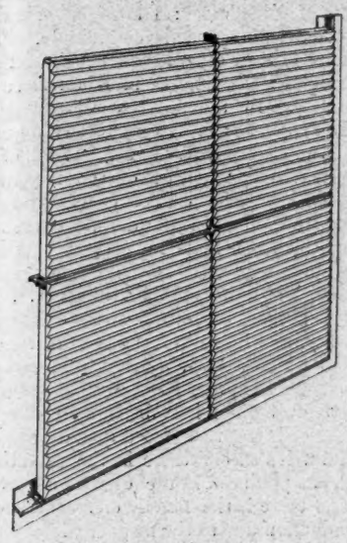
Copper Depositing Plant at Finsbury.



Luxfer Prism Reflectors.

object in streets, where additional light is diverted by it to useful effect in offices and basements.

The depositing plant consists of two of Messrs. Ernest Scott and Mountain's multipolar dynamos, each capable of giving 1,000 amperes at from 2½ to 5 volts; these dynamos replaced five American machines which were trying to do the work previously. The switchboard is a large but simple arrangement, illustrated on the opposite page; by means of the large flexible cables and plugs,



Luxfer Prism Reflector.

either of the six depositing tanks can be supplied with current from either dynamo, any tank can be connected in series with any other, and any number of tanks can be put in series, or, in fact, in any combination of series and parallel, and the voltage at the switchboard adjusted by the shunt rheostats accordingly.

The tanks are 24 ft. long by 4 ft. 6 in. wide, and about 6 ft. deep, and the work is suspended in them with copper strip, hung from the longitudinal conducting bars, which are of steel, cased with copper. Each tank when full of work uses a current of about 1,000 amperes.

The current is carried from the switchboard to the tanks by bare copper strip on insulators and wall brackets.

The dynamos are driven either by a gas engine through shafting, or by a motor of 25 H.P. taking the supply company's current at 550 volts.

The company also manufacture by the same process screens and partitions in ornamental, coloured or plain glass in very large variety, one of which is illustrated on p. 614. When composed of sections not exceeding 4 in. square, and not less than ¼ in. thick, these screens are passed as fireproof by the L.C.C., the setting being so secure, that however much the glass is cracked by fire and water, it does not drop out of the frames.

It is noteworthy that in the case described, an electrolytic process is employed for the actual production of manufactured articles, as distinct from its usual office of coating one metal with another for decorative or protective purposes, as in electro-plating and galvanising, or the production of chemical compounds such as bleaching soda and raw metals, such as aluminium, electrolytic copper, &c.

The whole of the electrical work has been carried out by Messrs. Tyler & Duncan, London representatives of Messrs. Ernest Scott and Mountain, Limited, Newcastle-on-Tyne.

CALCIUM CARBIDE PATENTS IN EUROPE AND AMERICA.

It has been authoritatively announced that the Geschäftstelle vereinigter Carbidfabriken, of Nürnberg, is about to essay the overthrow of Willson's American patents for the manufacture of calcium carbide, in order that Continental carbide may be exported from Germany to the States. In view of the involved but interesting history of carbide patents and litigation in Great Britain, France, Germany and America, a chronological table of the most important events may, perhaps, serve to elucidate the following comments on the existing state of affairs:—

June 17th, 1890.—Application for Willson's English patent 9,361, 1890.

March 3rd, 1891.—Application for Willson's English patent 4,757, 1891.

August 9th, 1892.—Application for Willson's U.S. patent 492,377.

November 28th, 1892.—Application for Willson's English patents 21,696 and 21,701, 1892.

December 12th, 1892.—Moissan's first paper read to the French Academy.

February 21st, 1893.—Issue of Willson's U.S. patent 492,377.

February 9th, 1894.—Application for Bullier's French patent.

February 20th, 1894.—Application for Bullier's German patent 77,168.

February 28th, 1894.—Application for Willson's second U.S. patent.

March 5th, 1894.—Moissan's second paper read to the French Academy.

July, 1894.—Grant of Bullier's German patent.

August 27th, 1894.—Application for Willson's English patent 16,342, 1894.

September 1st, 1894.—Application for Willson's English patent 16,705, 1894.

January 16th, 1895.—Application for Willson's U.S. patent 541,137.

March 4th, 1895.—Application for Willson's U.S. patent 541,138.

June 18th, 1895.—Issue of Willson's U.S. patents 541,137 and 541,138.

June 26th, 1896.—Application refused to antedate English patent 16,705, 1894, to February 28th.

June 16th, 1898.—Bullier's German patent annulled.

From this list we have omitted all Bullier's British patents, because the Bullier (*i.e.*, Moissan) and the Willson processes are identical, both referring to the use of the arc in contradistinction to the resistance furnace; and, moreover, because they are later in date than those held by Willson, who therefore had priority over the Frenchman.

Now, it will be seen that Bullier's German patent was finally annulled by the Courts in 1898 on the grounds of anticipation and lack of patentability. The corresponding French patent, however, has been upheld in two actions, in so far that it has enabled a claim for infringement to be gained; but at the present we understand another reputed infringer is proposing to test the validity of the grant as plaintiff instead of defendant. On January 30th last an action was brought in the English Courts by the Acetylene Illuminating Co. against the United Alkali Co., which raised two issues:—(1) The validity of the English Willson patents; (2) the question whether the defendants were infringing them if sound. During the trial all Willson's patents were abandoned at the bar except No. 16,705 of 1894; and this was declared invalid by Mr. Justice Buckley on February 3rd. Formal notice has already been given by the plaintiffs of an appeal, and, therefore, the matter is still unsettled; nevertheless, without venturing to prejudge the case, we may question whether the decision will not be confirmed.

The defendants in that action produced evidence to show that they made carbide in resistance or incandescent furnaces, and did not use the arc at all. This point being admitted by the judge, they could have gained their cause on that count alone. But apart from this, Mr. Justice Buckley was clearly of opinion that English patent 16,705 contained nothing novel; Moissan had previously described crystalline calcium carbide, and had explained how to make it. The arc furnace was the Siemens furnace, and it was not used in a new way. Unless the promised appeal should succeed, therefore, the manufacture of calcium carbide is free in this country, for Bullier's untried English patents are all dated, as we have already said, later than that of Willson, and were not brought prominently before the Court. It would appear as if some misunderstanding must have arisen between Willson and his English agent over this patent 16,705, 1894, since an attempt was made in 1896 to obtain a special Act of Parliament to have it antedated to February 28th, 1894, which was the date of the corresponding application in the United States. This attempt, however, was unsuccessful, as the claim was not lodged within the statutory period, and accordingly the English date of September 1st stood. Bullier appeared by counsel against the granting of the Act, and claimed to be the first discoverer of the process referred to in the preamble of the Bill; but how he justified this amazing statement is not very obvious. Had this error not been committed, and had the contested patent dated from February 28th, 1894, the result of the trial might have been less easy to predict than it was, because a reference to our table will show that in that case Willson's application would have had priority over Moissan's second paper read before the French Academy of Sciences, a paper which contains so much exact information about the preparation and properties of carbide, that it alone might have sufficed to upset English patent 16,705, 1894.

On turning to the position of affairs in the United States, we find on our list that Willson holds three patents for the manufacture of calcium carbide. Of these, No. 541,138 is only the specification claiming the material which has been made according to the process described in No. 541,137, and the latter covers a method of winning calcium carbide in an arc furnace (only) by an alternating current (only). No. 492,377 describes a "process of decomposing (deoxidising) refractory metallic compounds which consists in subjecting the compound, while commingled with sub-divided carbon in sufficient proportions to prevent formation of a bath of fused compound, to the sustained heat of an electric arc. . . . ." The essential feature accordingly here is the excess of carbon and the non-fluid bath—conditions which do not represent the manufacture of calcium carbide as carried on to-day. It is very doubtful, therefore, whether this specification is of much legal value, although it actually claims the substance calcium carbide as a material which decomposes water and "oxidises" in the air. There can be no dispute that Willson could and did make carbide at and before the time of his application for this patent; inasmuch as the date of May 4th, 1892, has been placed on record as the first occasion when carbide was sold—it fetched a price of $2 per lb.

Were the process in the grant a sound one, the patent would give Willson a clear priority over everybody, for it antedates even Moissan's first paper to the French Academy. Nevertheless we

fancy U.S. patent 541,137, with its partner 541,138, is Willson's only hope in the American Courts, for the application he made in the States on February 28th, 1894, cannot be traced any further, although from remarks made during the English trial before Mr. Justice Buckley, it must be more or less identical with the English patent which has not survived attack on this side. At that time he believed only in the alternating current, for he says: "By this process the yield of carbide per H.P. is almost doubled over a process of using a direct current." Again: "The action of the alternating current is likewise essentially different from that of a direct current, producing a series of explosions, the effect of which seems to be to feed the pulverised material into the arc." Once more: "It has been generally understood that the production of calcium carbide was due to an electrolytic action, and not due to a smelting action. I have demonstrated that the action is purely a smelting action under the conditions here described."

Hence it seems to follow that the Union Carbide Co., whose headquarters are at New York and Chicago, and who control the whole of the carbide factories in that country, can have no power to stop the manufacture of calcium carbide by a direct current process; and since direct and alternating current carbides are alike in their chemical and physical properties, the company cannot identify any particular parcel on the market as having been made by an infringing process. Hence, too, while the company may possess rights to see that no competitors employ a direct current in their carbide furnaces, they can do nothing with any description of carbide when once it is made; for alternating current carbide, as a specific material, is not capable of being patented in the United States according to the laws obtaining there. Therefore, we imagine, the Europeans can safely import into the States, so far as legal restrictions go; but as the price of carbide in America is approximately £16 per long ton, while large quantities are being quoted at Hamburg at about £15, there does not appear much margin to allow for shipment and any import duties that may be imposed. Of course the European syndicate may be able to sell profitably much below £15, as we suspect they are trying in their own countries to make good some of the loss the factories have sustained through mad over-production in the last two or three years before the existing combination controlled the output. If, however, this is true, it seems rather a pity that they raised the European price so suddenly and enormously; because certain it is that they have disgusted many regular consumers of acetylene in rural districts, who have returned temporarily or permanently to the use of other artificial illuminants.

THE OLD AND THE NEW ELECTRICAL THEORY.

By ALEX. P. TROTTER.

(*Continued from page* 577.)

Energy.

Having asserted not only that there is no such thing as electricity, but that the very idea is useless and misleading, and having stated that an electric current is not the flow of a fluid, and that while electrical phenomena may be due to displacements of the ether, the theory is not advanced enough for us to describe the directions in which such displacements exist, let us make a fresh start from another point of view. In ordinary telegraphy or in wireless telegraphy there is a transmisson of energy. For practical purposes, energy is of two kinds, potential and kinetic. A pendulum at the end of its swing is an example of a body having a store of potential energy. It may be hung up in that position, and after any interval it may be released. The energy which it possesses is due to the position of the pendulum with respect to its position of equilibrium. At the bottom of its swing the energy is all kinetic; this energy is due to its motion. At any intermediate position the energy is partly potential and partly kinetic. The tendency of modern physics is to suggest that all energy will ultimately be found to be kinetic. In any case, energy has not objective existence as a material thing, for it depends upon relative position or relative motion of bodies. A "thing" has been defined as "isness," and matter as "isness possessed of somewhatness." Energy doubtless "is," but it is not possessed of "somewhatness."

The definitions of energy are all unsatisfactory; the most common one is that energy is the capacity for doing work. Work can be clearly defined; and force, one of the factors of work, though not so easily defined in an absolute manner, acquires a satisfactory definition from its relation to work; there is no temptation to regard either work or force as things, and the thinginess of energy, as Oliver Heaviside calls it, seems to be suggested by its conservation or indestructibility.* Force is measured by engineers, and for many purposes by physicists also, as the weight or heaviness of so many pounds or grammes. Work is measured as the raising of weight through a distance, or a force acting over a distance, in foot-pounds or gramme-metres. Energy, the capacity for doing work, is measured in the same units. Power is the rate of doing work; 1 horse-power is defined as 33,000 foot-pounds of work done in one minute. The electrical measurement of these quantities is equally definite, and the electrical mode of measuring them is far more accurate than the mechanical. In the unfortunate language of the old electrical theory, energy is the product of a quantity of electricity and of an electromotive force. "And, of course," writes Oliver Heaviside, "neither of the factors can be energy. That is, electricity cannot be energy as heat is. But concerning the often-asked question 'what is electricity?' I can attach but little importance to the answer itself. But the question 'what is the mechanism of electrical phenomena?' is quite another thing. . . . It might then be found desirable to completely alter the nomenclature of electrical theory, and instead of the present functions to employ others to which a plain dynamical meaning can be assigned. Of course, the present established relations would remain true, but for them might be substituted equivalent relations in terms of better understood quantities.

"Now, in Maxwell's theory there is the potential energy of the displacement produced in the dielectric parts by the electric force, and there is the kinetic or magnetic energy of the magnetic induction due to the magnetic force in all parts of the field, including the conducting parts. They are supposed to be set up by the currents in the wire. We reverse this; the current in the wire is set up by the energy transmitted through the medium around it. The sum of the electric and magnetic energies is the energy of the electric machinery which is transmitting energy from the battery to the wire. . . . A line of energy-flow† is perpendicular to the electric and magnetic force, and is a line of pressure.

. . . . Energy is poured out of the battery *sideways* into the dielectric at a steady rate. The lines of energy-flow terminate in the conductor. The amount of energy entering a given length of the conductor is the same wherever that length may be situated. The lines of energy-flow are the intersections of the electric and the magnetic equipotential surfaces. . . . . In passing from the battery to the wire through the dielectric the energy-flow is continuous, the state being steady (or the ether machinery being frictionless); but directly it reaches the conducting matter of the wire, dissipation commences and the flow begins to fall in strength, and on reaching the axis has fallen to nothing."

"But in the battery there is a very remarkable thing taking place, namely, the loss of chemical energy at a steady rate and in the system generally, a still more remarkable thing, an exactly equivalent gain of heat. . . . . How does it get there? The natural answer is, Through the wire. But to get to the further parts of the wire it must go through the nearer, hence there must be what we call an energy-flow, which, in the wire, at a given place, would be the rate of transfer of energy through a cross-section there. Now, which way is the energy-flow directed? It would seem only fair to let it go both ways equally from the battery. Let it be so at first. Then there is an energy-flow entering the wire equal to one-half of the loss of heat.‡ It fails in strength regularly up to the middle of the wire, where it is zero. Similarly the other energy-flow goes through the earth to the remote end of the wire almost unabated in strength, and is then directed to the middle of the wire, where its strength also falls to nothing."

"This seems absurd. Then let the energy be directed one way only, say, with the positive current. If the positive pole of the battery is to line, we have an energy current in one direction all round the circuit and back through the earth. If maximum strength is at the battery, it falls to nearly nothing at the distant end. . . . There is no getting

* "Electrical Papers," O. Heaviside, Vol. ii., pp. 92, 562.

† In this passage for "energy-current," "energy-flow" has been substituted.

‡ In the original, "dissipativity" for "loss of heat."

at anything definite, except that the energy current must vary very widely, though regularly, in strength, whilst there is nothing to fix which way it is directed, or where the maximum strength is. . . . Had we not better give up the idea that energy is transmitted through the wire altogether? . . . . The transmission takes place entirely through the dielectric. What, then, is the wire? It is the sink into which the energy is poured from the dielectric and there wasted. . . .

"Since in starting a current the energy reaches the wire from the medium without, it may be expected that the electric current in the wire is first set up in the outer part, and takes time to penetrate to the middle." This is precisely what happens in the case of alternate currents, and in practice it is found economical to employ hollow conductors for large alternating currents, since they would not penetrate to the middle of a large solid conductor.

Conductors.

The theory that energy travels through the dielectric, that is, through the air, in the ordinary cases of telegraphy and electric lighting, or through the gutta-percha in the case of a submarine cable, has been received with ridicule and positive incredulity, so firmly has the idea of a flow of something along the wire, become established. It has been asked ironically, whether the energy of a steam engine employed to drive a threshing machine travels through the air and *not* through the belt. The air has not got much to do with it, but how would the energy be transmitted if it were not for the reaction of the ground on which both engine and machine stand? As a matter of fact, this reaction, which is a transmission of force, one of the factors of energy, is essential. If both were floating in space, free from such constraint, the engine would tend to revolve round the machine, and certainly no useful driving would be done.

The real use of the wire in telegraphy or electric lighting, is to guide or direct the energy from the source to the sink. The word "conductor" may be honoured as perhaps the only one among ordinary electrical terms that is justified by its literal meaning. Electricity professes to name a thing which is no thing; current suggests that something flows, a suggestion wholly unwarranted by the facts; electromotive force is neither electro-motive nor is it force.

The way in which a wire guides the energy will not be clearly explained until the nature of the displacements of the ether have been discovered. When the waves of the sea move towards an embankment which is almost at right angles to the direction of their motion, and break against it, the breaker which is the evidence of an expenditure of energy, travels along the embankment, and is guided by it. The embankment itself is heated, though to an imperceptible extent, by this expenditure of energy. The wall of a whispering gallery guides and concentrates sound which really travels through the air. These analogies are very crude, and must not be pressed.

(*To be continued.*)

BUSINESS NOTES.

The Urban District Council of Teddington v. the London United Tramways (1901), Ltd.—In the Vacation Court on Wednesday last week, before Mr. Justice Jelf, the plaintiffs in this action sought to restrain the defendants from constructing electric tramlines at Teddington in such a manner as to alter the level of the road. On the application of counsel the motion was directed to stand over for consideration of the learned Judge in chambers.

This case was again before Mr. Justice Jelf on Thursday last week, the object of the motion being to restrain the defendants from proceeding with the construction of their tramlines at Teddington, on the ground that the effect of the proposed works would be to alter the level of the road. His Lordship, after some argument, declined to make any order on the motion, except that costs be costs in the action, but without prejudice to any further application.

H. G. Stewart v. The Special Telephone Directories, Ltd.—In the Vacation Court on Wednesday last week, Mr. Justice Jelf appointed the plaintiff, a director of the company, receiver and manager of the property and assets of the defendant company on behalf of the debenture holders.

Electrical Wares Exported.

Week ending Oct. 8th, 1901.		Week ending Oct. 7th, 1902.	
elaide	Value £399	Adelaide	Value £122
„ Teleg. wire	239	Alexandria	650
Alexandria	1,980	Auckland	96
Amsterdam	33	Beira. Teleg. mat.	109
Bangkok	84	Bergen. Teleg. cable	968
Bombay. Teleg. wire	32	Bombay	94
Brisbane. Teleg. poles & fittings	1,544	Calcutta	67
Buenos Ayres	625	„ Teleg. wire	58
Calcutta	364	Cape Town	823
„ Teleg. wire	326	„ Teleg. cable ..	3,099
Cape Town	69	Christiania. Teleg. wire ..	96
„ Teleg. sundries ..	1,194	Colombo	213
Colombo	19	Copenhagen. Teleg. wire ..	120
„ Teleg. mat.	200	Durban	355
Copenhagen	700	East London	751
„ Teleg. wire ..	153	Flushing	69
Delagoa Bay	132	Hamburg. Teleg. mat.	300
Durban	22	Hong Kong	41
Gibraltar	44	Lisbon	100
Gisborne	261	Melbourne	73
Halifax. Teleg. mat.	600	Odessa. Teleg. apparatus ..	86
Hamburg. Teleph. apparatus	120	Penang. Teleg. cable	242
Hong Kong	9	Perth	42
Madras	112	Rio de Janeiro	23
Malta	17	San Francisco. Teleg. cable	360,000
Melbourne	1,085	Shanghai	176
Rio Janeiro. Teleg. mat. ..	65	Singapore	64
St. Petersburg	266	Sydney	219
Shanghai	49	Wellington	73
„ Teleg. mat.	220		
Singapore	104		
Stockholm. Teleg. mat. ..	196		
„ Teleph. cable ..	181		
Sydney	409		
Teneriffe	95		
Townsville. Teleg. mat. ..	1,490		
Wellington	39		
Zanzibar	98		
Total ..	£12,688	Total ..	£368,888

Foreign Goods Transhipped.

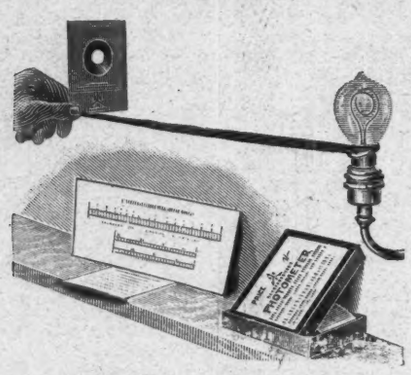
Perth. Elec. machinery	Value £93	Colombo. Elec. light mat.	Value £16
St. John, N.B. Elec. machinery	90	Durban. Elec. goods	30
		Gothenburg. Elec. apparatus	41
		Sydney. Elec. goods	60
		„ Elec. lamps	65
		Wellington. Elec. goods ..	38
Total ..	£183	Total ..	£250

Pocket Electric Lamp.—A very compact and neat little portable lamp, combined with a dry cell, has been introduced by Messrs. F. Darton & Co., of 142, St. John Street, Clerkenwell. One form of the lamp is shown in the accompanying figure; it is small enough to go into the vest pocket, and gives quite a bright light.

Of course it is not intended that such a lamp should be used for more than a few seconds at a time, and it would be unreasonable to keep it on for long periods without proportionately long intervals of rest; but for use at night, to consult one's watch, or, perhaps, to find the keyhole of the street door, it is quite suitable. The details are remarkably simple.

Electrical Machinery for India.—Last week an interesting test was carried out at the works of Messrs. Belliss and Morcom, Ltd., engineers, Birmingham, in their electrical machinery department, of a Crompton-Belliss 750 kw. combined steam dynamo for power and lighting. The set is one of two of this size which will be installed at the new works of the Calcutta Electricity Supply Corporation, Ltd., for which company three 250-kw. similar sets have been recently despatched for power purposes. The engines in all instances are of Messrs. Belliss & Morcom's patent, self-lubricating, quick-revolution, triple-expansion design, having only three cylinders, viz., high, intermediate and low pressure, thus ensuring the simplest possible design of engine, and the best for the purpose intended. The firm's automatic system of forced lubrication is employed to all the bearings at a pressure of 10 to 15 lbs. per square inch, by means of valveless pumps driven off the engine crankshaft, and arranged in an oil-well in the crank-chamber. The set runs at 230 revolutions per minute with a steam pressure at the engine of 160 lbs. per square inch, and is arranged to run non-condensing at present. The dynamos are of Messrs. Crompton's well-known multipolar type, fitted with slotted drum-wound armatures 7 ft. in diameter. The magnets are compound wound, the outside diameter of the yokes being approximately 12 ft. The commutators are fitted with carbon brushes, and all bearings are self-oiling. The weight of the armature alone is 13 tons. The plant, although primarily designed for lighting purposes, embodies all the essential qualities for traction work, and will, therefore, be equally suitable in that capacity if necessary at a future date.

Novel Glow Lamp Photometer.—Whilst it is easy to measure the current taken by an incandescent lamp, the determination of the candle-power is a very different matter. In fact, without the use of elaborate standards, and a specially fitted-up photometer room, it has, up to the present, been deemed an impossibility. As a consequence, the important question of candle-power has generally to be taken for granted by the buyer of lamps, and, under these circumstances, the measurement of the current consumption is of little use. To remedy this state of affairs, a small instrument has lately been devised by Messrs. Everett, Edgcumbe and Co. This very ingenious little apparatus (an illustration of which is given below) consists essentially of a modified form of Leeson disc photometer. Two lampholders are provided, attached



Everett-Edgcumbe Photometer.

to an adaptor, so that connection can be made to any electric light fitting. In order to use the photometer, a divided scale, which is provided with a ring at each end that can be slipped over the lamp-holders, is put in place and stretched tight. Having obtained a point of balance in the ordinary way, the required candle-power is readily found, without any calculation whatever, by means of an ingeniously devised direct-reading logarithmic scale, which is practically equivalent to a specially divided slide rule.

The difficulty of obtaining a handy and reliable standard, and that of regulating the voltage, are overcome in the photometer of Messrs. Everett, Edgcumbe & Co., by making no attempt whatever to keep the voltage constant, and by employing a specially standardised lamp which forms part of the outfit, as the standard. As both the standard and the lamp under test are run off the same supply, any increase or decrease of voltage will affect both lamps equally, and the point of balance will remain practically unaltered.

It is stated that the method has the further advantage that the candle-power so found is, no matter how much the supply voltage may vary, the candle-power which the lamp would give at the standard voltage; which is, of course, what is required. It is clearly best in practice not to use the standard lamp throughout a series of tests, but to standardise another lamp from it, and to use this as a secondary standard.

It is claimed that with this set no specially-arranged dark-room is necessary, as any moderately-screened position is all that is required; or by hanging a few yards of black cloth over the photometer, an ideal photometric chamber can be readily improvised. When it is impossible for any reason to obtain a fair absence of light, a simple correction factor can be determined once for all, as explained in the directions which accompany the instrument, by interchanging the standard and test lamps, and obtaining a second point of balance. This will, however, be seldom found necessary. The direct reading scale already alluded to can be used to obtain the efficiency of the lamp in watts per candle-power, from the candle-power, known voltage, and measured current. For the latter purpose the Everett-Edgcumbe lamp-tester is a very handy instrument. This has now been so far improved as to be perfectly dead-beat, so that the readings can be taken with the utmost rapidity. It should be mentioned that the same instrument can be used for direct or alternating current, as required. In this case also, fluctuations of voltage will have but little effect on the result, and unless extreme accuracy is required, no voltmeter need be employed.

Every detail seems to have been most carefully thought out, and though, of course, a high degree of accuracy is not claimed, this simple apparatus ought to be of considerable utility.

Electric Light Agreements.—Judge Emden, at Lambeth County Court, on Friday, October 3rd, gave judgment in the case of the South London Electric Supply Corporation, Ltd., *v.* Morris Gouldsten, trading as M. Gouldsten & Co., tailors, at 1, Princess Mansions, Cold Harbour Lane, Brixton. Defendant had the electric light installed, and signed an agreement to pay 10s. a quarter rent for the meter for three years. After a short time he found that the light supplied was so bad that he had to use candles. Besides, it was three times more expensive than gas, so he returned to that illuminant. He paid the Electric Supply Corporation what he owed them, and asked them to remove the fittings, but they now sued him for two quarters' rent of the meter, although he had discontinued using the current.

Judge Emden asked if the plaintiff corporation intended to bind the defendant down to his three years' agreement, whether he used the electric light or not? Plaintiffs' manager replied in the affirmative.

Judge Emden: Your agreement is different to the agreement of a gas company. I do not consider it fair that a man should be charged whether he uses the light or not.—We have to get cost of installation back.

You would soon get the cost of the installation back at £2 a year.—No, sir.

George Brace, who lived next door to defendant, deposed to noticing the bad light supplied by electricity. It was nothing equal to that given by gas. Defendant told him he would have to go back to gas, which, besides being better, was much cheaper.

Defendant, in reply to an observation from plaintiffs' manager, said he put new lamps on every fortnight. He was advised by the Electric Corporation's clerks to take off the globes. He did so, but there was no improvement.

Plaintiffs' manager said defendant's premises were close to the works. It was merely a question of extra expense, not of bad light. Defendant alone had complained of bad light.

Judge Emden: Do not say that. I had a case before in this Court where there was a complaint of bad light against your corporation.

Under the Act they can summons us if we supply light which does not come up to the proper pressure.

Yes, poor people are likely to summons you for that. You won't let defendant off this three years' agreement?—Certainly not.

Judge Emden: Well, then, I am reluctantly obliged to give judgment for the plaintiffs under this agreement. The moral is that people should not sign these agreements. Although I am compelled to enter judgment for plaintiffs, I make no order as to costs, as I consider the agreement one-sided.

On the 'Phone.—The Electrical Trades Union is now connected with the Post Office telephone service, No. 623 Central, and this may be of some assistance to employers requiring workmen at short notice.

Smoke Abatement.—The Lighting, Heating, and Smoke Abatement Exhibition will be opened at the Crystal Palace on Saturday, December 13th. The Smoke Abatement Society, of which Sir William Richmond, K.C.B., is president, is offering a substantial award for the grate best capable of consuming its own smoke. A congress is also to be held during the run of the Exhibition.

Catalogues, &c.—An illustrated list of transformers and transforming apparatus, chiefly three-phase, has come to hand from Tecnomasio Italiano Cabella, of Milan.

Messrs. W. A. S. Benson & Co., Ltd., of New Bond Street, have published a beautifully illustrated catalogue of their high-class electric light fittings, for which the designs have been registered. The chief characteristic claimed for the Benson fittings is that they are practical as well as decorative, and "depend for their effect rather on beauty of form and excellence of finish than on excessive or meaningless ornament." No expense has been spared in representing to the eye by artistic colouring and excellent printing the superior class of fitting designed and made by this firm for church and hall lighting, and for dining and drawing-room use. This well-bound book will, we have no doubt, be greatly in demand by electrical engineers and contractors engaged in installation work of all kinds. A separate 16-page pamphlet gives the present prices of the fittings shown in the designs collection.

Messrs. C. Nurse & Co., of Walworth Street, S.E., have sent us a copy of their No. 12 catalogue of engineers' and joiners' tools and machinery, just issued from the press.

The Lighting Corporation, Ltd., of Bloomsbury Street, W.C., has sent us a copy of its illustrated and priced catalogue of "Wenham" incandescent electric lamps of high and low voltages, plain and fancy, and of all candle-powers. The "Wenham" enclosed arc lamps for continuous and alternating current circuits are also particularised.

The Western Electric Co. has issued a new price list, describing its telephones for private line installations. Wall and desk sets, intercommunication instruments, and parts are very neatly shown, and a number of exterior wiring diagrams are given.

Board of Trade Approval.—The Board of Trade has, according to the *London Gazette*, of September 26th last, approved of the Westinghouse integrating wattmeter. This meter is of the alternate current induction type, simple in construction, and accurate over a wide range. In all cases, whether on single or poly-phase circuits, it measures energy direct in kilowatt-hours. The construction of this meter is pretty well known, and its use is extending rapidly on alternating current power systems in this country.

Book Received.—Papers presented by Seventh Annual Convention of the International Association of Municipal Electricians, held at Richmond, Va., U.S.A., October 7th, 8th, 9th, 1902

Bankruptcy Proceedings.—At Warrington Bankruptcy Court last week, Walter Morton and William Trevitt Sampson, who carried on business in partnership as electrical and mechanical engineers, appeared for their public examination. The liabilities amounted to £307, and the assets were estimated to realise £101, leaving a deficiency of £225 15s. 7d. Morton had separate liabilities amounting to £84, with no assets. The causes of failure were alleged by the bankrupts to be loss on a contract at Wallasey and bad trade. The examination was closed.

Liquidation.—A meeting of the Reno Electric Stairways and Conveyors, Ltd., is to be held at 70, Finsbury Pavement, E.C., on November 3rd, to hear an account of the winding-up.

The South American Electric Co. v. Moreno.—In the Vacation Court on Wednesday, before Mr. Justice Jelf, Mr. Bramwell Davy, K.C., asked for an injunction to restrain the defendant from purporting to act as secretary of the plaintiff company, and for an order for the delivery up of the minute and other books of the company. Learned counsel stated that the defendant was a director of the company as well as secretary, and from the latter office he had been dismissed. The defendant urged that he had not been properly dismissed, and he also claimed to have a lien upon the books with respect of money owing to him by the company. His Lordship, after some argument, granted an interim injunction, and made an order for the delivery up of the books.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—After comparing the cost of electric and gas lighting for two of the principal thoroughfares in the town, the T.C. has decided to adopt electricity, with arc lamps.

Ashton-under-Lyne.—Owing to the change of voltage, the whole of the street incandescent lamps, and those used by private consumers, have been replaced by new ones, without the slightest inconvenience. The work, which comprised the alteration of 16,000 8-c.p. lamps, was carried out under the supervision of the electrical engineer, Mr. Appelbee.

Aston.—On September 30th, at the laying of the foundation stone of the new electrical power station of the U.D.C., the chairman of the Tramways and Electric Light Committee (Mr. J. J. Gittings) stated that the plant which was to be installed would be sufficient to supply current to the whole of the tramways throughout the district, and in addition would carry a maximum load of 40,000 8-c.p. lamps. Over 12 miles of cables would be laid for private house and street lighting, and for supplying power for large works and the tramways. The total cost would be about £67,000. The Council had been recommended to adopt the lowest price charged in any town in the United Kingdom—1½d. per unit for 22 hours of the day, with 6d. per unit between the hours of 6 p.m. and 8 p.m. in winter and 7 p.m. and 9 p.m. in summer. The lower charge compared with gas at 9d. per 1,000 cub. ft., which was a third of the present price of gas at Aston.

The L.G.B. has given permission for the U.D.C. to raise a loan of £52,436 for electric lighting purposes.

Barrow.—An inquiry was held last week by Mr. Malet, L.G.B. Inspector, with regard to an application by the Corporation for sanction to borrow £20,000 for electric lighting purposes, in view of further extensions being required to meet the public demand, which had increased rapidly. In January, 1898, the first loan of £29,000 was authorised, and since then small loans had been received amounting in all to £58,575.

Belfast.—The City Council has received an intimation from Messrs. Harland & Wolff, Ltd., stating:—"That as there would appear to be no immediate prospect of obtaining from the Corporation the current they require for driving their machinery, they regret to say they are now obliged to make other arrangements, and must therefore withdraw their application and the corresponding guarantee of May 27th last." It was resolved—That in acknowledging receipt of Messrs. Harland & Wolff's letter, the committee desire to point out that so far as they are concerned no delay has taken place. The application was received on May 23rd, and on receipt of the guarantee, dated May 27th, a special meeting of the committee was held on May 28th, when the application was granted, subject to the L.G.B.'s sanction to the loan required for laying the mains being obtained; the Board having held their inquiry here on July 22nd, the committee are now awaiting the Board's decision. The loss of this fine source of revenue is a misfortune to the city.

Berwick.—Electricity works are about to be erected on the Quay by the Urban Electric Supply Co., which is in negotiation for lighting the town.

Beverley.—Owing to the Edmundson Co. having asked for £5,000 more than the £14,704 loan secured by the T.C. for providing an electric light installation for the town, the Corporation on October 1st decided to allow any other company to undertake the work for £14,704.

Bloemfontein.—The Council has approved the specifications for electric lighting installation, and a contemporary says that Messrs. Davis & Soper have received definite instructions to accept one of the tenders sent in some time ago.

Brighton.—Another discussion relative to the position of the Corporation's consulting electrical engineer, Mr. Wright, with the Mutual Electric Trust Co. and the Reason Manufacturing Co., Ltd., of Brighton, took place at the meeting of the T.C. on October 2nd. Mr. Tozer had asked for counsel's opinion to be taken on the connection of Mr. Wright with the Mutual Electric Co., which owned shares in the Reason Manufacturing Co., from whom the Corporation purchased goods, but it was stated that it was not deemed advisable to grant this request because, when Mr. Wright's appointment was altered on February 26th, 1900, he informed the Committee, and it came to the Council, that he was a shareholder in the Mutual Electric Trust Co., which would, in the near future, be merged into the Reason Manufacturing Co. Although he gave that information, the Corporation decided to retain his services. Mr. Tozer intimated that he intended to obtain counsel's opinion himself, but Mr. Broadbridge said that surely the Council was studying the interests of the ratepayers when it could buy meters from the Reason Co. at nearly half the price it would have to pay elsewhere. In further discussion it transpired that by special arrangement the Reason Co. supplied to the Corporation demand indicators at a specially cheap rate with no royalty, and the Mayor observed that there was no profit accruing to the Reason Co. from the Council. The matter then dropped.

On Saturday last the Mayor (Alderman Stafford) opened the Electrical Exhibition at the Aquarium. Practically all the local electrical firms were represented, among which there were some very artistically arranged stalls, chiefly devoted to the various forms of electroliers, desk fans, &c. A good show was made by Mr. F. Fileman, of Brighton, who had a nicely arranged selection of fittings, which were all shown off to the best advantage. Among the novelties may be mentioned several "pom-pom" shells from South Africa neatly made up into candlesticks and electric table lamps. Messrs. Babcock & Wilcox had a model boiler on view, while Messrs. J. H. Holmes & Co., of Newcastle, exhibited a number of Lundell motors, many of which were in operation. Among other exhibitors may be mentioned Messrs. Bruce Peebles & Co., Messrs. Veritys, the Electrical Co., Ltd., showing Nernst lamps, the British Insulated Wire Co., Ltd., and many others. Some of the Gilbert Co.'s yellow type arc lamps were employed for lighting the exhibition.

Burnley.—The T.C. on October 1st decided, on the recommendation of the Electricity Committee, to instal additional plant at the electricity works, in order to meet the increased demand through the extension of the tramways, at a cost of £3,500.

Buxton.—Messrs. Rowcliffe & Co. have submitted to the U.D.C. a scheme for supplying the town with electricity for lighting, power and traction purposes. It was decided to go fully into the matter at a special meeting.

Cardiff.—The town clerk has prepared a report upon the South Wales Electrical Power Distribution Act, so far as it affects the borough of Cardiff. The sub-committee, to whom the question of access to the property of the Cardiff Railway Company for the purpose of supplying electrical energy was referred, has endeavoured to get an appointment with Sir W. T. Lewis in reference to the subject, but Sir William is laid up with an attack of influenza.

Cheltenham.—The T.C. on Monday decided, owing to the neglect or refusal of the R.D.C. to give its approval to the Council extending the electric light mains through Prestbury, to withdraw the proposed prov. order for extension of the lighting area to the adjoining parishes.

Cheshire, Stafford and Derby Power Scheme.—Power will be applied for in the next session of Parliament by a syndicate of capitalists to erect electric generating stations and lay mains for the supply of electricity throughout a district comprising the greater part of Cheshire, North Staffordshire and the north-western portion of Derbyshire (including Harfield and Whorley Bridge), not included in the Derby and Notts Act. The area of the district is 1,770 sq. miles, and it has a population of 1½ millions. Within this area there are four county and 12 non-county boroughs, 44 urban districts, and 28 rural districts. The scheme will be on the same lines, generally, as that of the Lancashire Electric Power Act, and other similar Acts already granted by Parliament, and the district will join up to that covered by the Lancashire, Yorkshire, Derbyshire and Notts Acts. The chief objects of the company are to supply electricity and produce gas for power purposes; and it will undertake to supply local authorities with electricity in bulk for lighting and other purposes within their own areas. The promoters are in communication with the local authorities, and ask for their co-operation on the ground that the undertaking will be greatly to the public advantage. Pending the receipt of fuller details, there is some reserve on the part of the authorities, but the trend of public feeling throughout the district is distinctly favourable.

At its last meeting the U.D.C. of New Mills had before it a letter from the solicitors for the promoters of this scheme. The Council deferred consideration of the matter.

Clyde Valley Power Scheme.—According to the *Glasgow Evening News*, a contract to the value of £500,000 has been placed with the Westinghouse Company, London, by the Clyde Valley Electrical Company, Glasgow, for the equipment of two generating stations, which are to supply electrical power for industrial purposes over an area of 755 square miles.

Cornwall Power Scheme.—A meeting was held last week of the Cornwall Electric Power Syndicate, Ltd., at which important reports were considered and arrangements made for

meeting the demand of the consumers in the county who are urgently needing an immediate supply of electrical energy, by installing temporary plant.

Derby.—The T.C. on October 1st decided that £6,948 should be applied, out of the profits of the water undertaking, to the district fund, to cover the deficiency on the electric lighting account for the two years ending March 31st, 1902, and the additional quarter's interest charged on the electric lighting account. We hope that advantage will not be taken of this financial operation to declare a profit on the electrical undertaking!

Dover.—Electricity is to be utilised for working the cranes used in loading and unloading mails and baggage on the Continental steamers. The cable from the electric light works to the Admiralty Pier will be 1¼ miles long.

Dudley.—The balance-sheet of the Corporation electric light undertaking for the year's working ending March 31st shows that £41,500 have been borrowed, and that £44,825 have been expended on buildings and equipment. On the year's working there has been a gross profit of £2,439, but there has been paid, in principal and interest on loans, the sum of £2,829. Claims to an amount exceeding £300 have been made against contractors for supplying unsatisfactory material.

Eastbourne.—The T.C. has reduced the price of energy to large consumers to 4½d. per unit.

Edinburgh.—An explosion occurred last week in an electric light manhole in the High Street. The cover of the manhole, which was made of cement, weighing about 1 cwt., was thrown up into the air a distance of 6 or 7 ft. The street was left in darkness for about an hour, when the staff of the electricity department effected the necessary repairs.

Exeter.—The electricity revenue account for the year ending December 31st last shows gross profits amounting to £2,894 14s. 7d. The interest for the year amounted to £991 10s. 8d., sinking fund, £1,023 6s., and the net surplus for the year £879 17s. 9d. The total expenditure was £5,390. The net surplus from the last account was £1,987. Accumulated surpluses and reserve fund total £3,617.

Halifax.—The T.C. at a meeting on Wednesday last week decided to make application to the L.G.B. for power to borrow £28,000 for the extension of the electricity undertaking. The electrical engineer (Mr. W. M. Rogerson) stated that the present plant was fully loaded, and should a breakdown occur on any of the present generating units there would be no spare plant to take its place. The average yearly increase in demand for the last three years was 411 KW. He estimates that in the contemplated extensions one new 700-KW. steam dynamo will be required.

Hex River.—The Cape Orchard Co. is erecting a refrigerating chamber for the storage of fresh fruit. The machinery will be driven electrically by means of a turbine plant. The contract for the plant for developing and transmitting the electric power has been placed with Messrs. Siemens.

Honley.—The U.D.C. has applied to the L.G.B. for a loan of £4,800 for electric light purposes.

Kalk Bay—Muizenberg.—The local Council recently passed a resolution to the effect that no person shall sell or supply within the municipal limits any electricity, electric energy, or power without the permission of the Council given in writing.

Kettering.—The L.G.B. has sanctioned the raising of a loan by the U.D.C. for the provision of a refuse destructor and electricity works.

Kildare.—Last week Mr. P. C. Cowan, L.G.B. Inspector, concluded the holding of an inquiry into an application by the Naas No. 1 Rural District Council for a loan of £3,000 to provide a system of public and private lighting by electricity for the town of Kildare. The inquiry had been opened on August 25th.

Kingston-on-Thames.—The T.C. has fixed the following charges for energy for motors:—3d. per unit up to 5,000 units, with a reduction to 2½d. per unit if the quantity of energy used on the same premises during a year exceeds 5,000 units, and a further reduction to 2d. per unit if over 10,000 units are used. The Corporation reserves its right to discontinue, if necessary, from 5.30 p.m. to midnight, the supply of energy to such motors supplied on the reduced rates of 2½d. and 2d. per unit.

Lewes.—An animated discussion took place at the meeting of the T.C. on October 1st relative to the lighting of the public lamps. A scheme for lighting a portion of the town by means of 12 arc lights, one 32-C.P. lamp, 12 16-C.P. lamps, two 10-C.P. lamps, and two 8-C.P. lamps at an estimated cost of £223 10s. per annum, had been placed before a committee by the Electric Lighting Co., but as gas lighting only cost £190 7s. 3d., the Council resolved not to make any change.

London.—CITY.—The City Corporation, on the recommendation of the Streets Committee last week, decided to offer no opposition to the re-introduction of the L.C.C. (Electric Supply) Bill subject to the insertion of a clause protecting the rights of the Corporation under the various Electric Lighting Acts and Orders affecting the City.

GREENWICH.—The Blackheath and Greenwich District Electric Light Co., Ltd., has agreed with the Borough Council to supply energy to the Council's premises for three years at 3½d. per B. of T. unit.

L.C.C.—The Council, on reassembling on Tuesday, sanctioned loans of £5,000 to the Battersea Borough Council for electric lighting purposes, and £25,000 to the Fulham Council for similar works.

The Highways Committee presented a report in reference to the Council's Electric Supply Bill, which was rejected by a Select Committee a few months ago. Having regard to the great importance of the Bill in respect of uniformity, efficiency, and economy of supply, the Highways Committee stated they had thought it right to consult the Borough Councils as to whether it should be re-introduced in the next session of Parliament. Replies had been received from 19 out of the 29 Borough Councils, and they encouraged the Committee to hope that a further attempt would receive a large measure of support. The Council resolved to promote a Bill in the next session on the same lines as those of the rejected Bill, and to afford the Borough Councils an opportunity of expressing their views on the draft.

It was announced by the Highways Committee that the Metropolitan Electric Supply Co. had given notice of intention to lay extra-high pressure mains from the station at Willesden along various roads and streets to the station in South Place. The works, in so far as London was concerned, would be situated in Paddington and Marylebone, but the latter Borough Council had expressed disapproval, and the company appealed to the Board of Trade. The appeal was heard on September 4th, when the arbitrator decided that the route of the mains should be altered for some portion of the distance, and that the company should submit an amended notice and plans. The company had, however, not forwarded these, and the Committee had not approved the proposed works.

The Highways Committee also referred to a notice received from the County of London Co. of intention to lay low-pressure mains along Wyneham Road and Beckwith Road. With the exception of those for a very small portion of Beckwith Road at its southern end the works would be within an area which was formerly a part of Lambeth, but which had been transferred to Camberwell under the London Government Act, 1899. As, however, the transference did not alter the area specified in the prov. order under which the notice was served, a portion of the works would be outside the area of supply, and the Committee had therefore expressed its disapproval, and at the same time had pointed out to the company the position of the matter.

Louth.—The Corporation has retained Messrs. Handcock and Dykes, of Westminster, to advise it with regard to its electric lighting order, and to prepare a full report as to the capital outlay and system to be adopted.

Montreal.—A five-year contract for the supply of the electric power to run the new pump for the high level reservoir was awarded recently by the City Council to the Lachine Rapids Hydraulic Co. The price is $20 per horse-power-year, making the cost for 400 H.P. for the period mentioned, $40,000.

Newport (I.W.).—The T.C. has decided to have 30 arc lamps erected in the town. The energy will be supplied by the Isle of Wight Electric Light and Power Co.

Nottingham.—The electrical engineer (Mr. H. Talbot) reports that the plant at the Talbot Street station has been increased during the year by the addition of two steam dynamos of 700 I.H.P. each. This last addition completes the equipment of this station. The power of the plant installed is 8,925 H.P. Three of the 700 I.H.P. steam dynamos are at present being used for traction purposes, but the whole of the traction load will shortly be transferred to the new power station at St. Ann's Well Road. When this is completed, the three steam dynamos will be available for meeting the increased demand for lighting and power. The distributing mains have been extended in 43 directions during the year, the total extension being 3 miles. The total length of distributing mains laid is 36 miles. The number of applications received for a supply of electricity on March 31st was 1,867, as compared with 1,529 on the same date last year. The number of units sold in the year was 4,094,897, as compared with 2,312,557 during the previous year. The cost of production shows a decrease in every item. The total engineering costs have been reduced from 1·45d. to 1·02d., and the total costs, including sinking fund and interest—from 2·43d. to 2·06d. The first portion of plant at the St. Ann's Well Road power station is erected, and the station should be ready to take the traction load by the autumn.

The Nottingham City auditors, in their annual report to the City Council, state that the surplus revenue amounted to £26,840 3s. 6d., as against £17,919 16s. 6d. in 1901, out of which £6,500 had been appropriated to the relief of the rates. The sales of energy amounted to £43,885 6s. 8d. For electric traction the traffic receipts were £59,965, and advertisements £559 1s. 8d. The expenditure, including electric energy, £6,843 14s. 5d., traffic expenses £12,481 19s., &c., left a surplus of £37,607, out of which £12,000 was devoted to the relief of the general district rate. In the electricity department the capital expenditure is £316,143 10s. 7d., and the sinking and reserve fund £33,657 12s. 5d., which equals 10 65 per cent. for eight years. In the tramways department the capital expenditure is £420,073 14s. 8d., and the sinking and reserve fund £38,375 8s. 10d., equalling 9·13 per cent. for five years.

Manchester.—Considerable discussion prevails in the city on the position of the electricity undertaking. There was a long discussion at a meeting of the Electricity Committee on Friday last regarding a report submitted by Mr. Metzger, the engineer, but no decision was arrived at thereon. It was stated at a recent meeting of the City Council, that the turnover of the Gas Committee was £763,210, while that of the Electricity Committee with almost the same capital, was £134,462.

At the last meeting of the City Council, a statement was made, showing the present position of the undertaking and its relation to the tramway service. It appears that the Electricity Committee was led astray by a miscalculation 18 months ago as to the number of tram cars likely to be run. When the existing routes were opened not half the number estimated were put on, though electric plant had been provided sufficient for the full estimate. In December next, and in March, 1903, the tramways department will have completed, and will be in a position to open, additional routes for traffic; so that in six months from the present time there ought to be 638 cars running, and by the end of next year, allowing for other routes remaining to be opened, and cross routes, 119 more—in all 757 cars. The Electricity Committee has provided plant sufficient for 700 cars, but, from the proportion the Tramways Committee are putting on new routes at the present time, it is considered doubtful if the number will exceed 500. As a result the Electricity Committee will find itself in possession of plant capable of providing power for some 250 cars above the number actually running. The Electricity Committee naturally complains, in face of these facts that it should be charged with overstocking the works.

At the same time the Electricity Committee wished to avoid a repetition of the disaster of 1901, when it had to refuse 60,000 8-c.p. lamp connections, on account of the plant not being available for producing the requisite supply. It, therefore, looked ahead somewhat, and ordered the necessary machines to deal with supplies till the end of 1904. The last of the machines ordered is not expected to be running until March, 1904.

The statement to the effect that the capital expenditure of the electricity department is equal to that of the gas department, whilst the latter has five times the revenue, has no foundation in fact. The accounts to March 31st, 1902—the last published—show that the capital of the electricity department is barely half that of the gas department.

Another injustice to the Electricity Committee arises from the gas competition. As far back as 1897 the City Council authorised the Committee to make arrangements for street lighting, and specified the streets to be lighted. It was also understood that all tramway routes would be lighted by means of arc lamps or some other form of electric illumination, and the Electricity Committee was led to instal sufficient plant in the new Stuart Street works to meet all requirements. The necessary cables have also been laid along the tram routes and the other authorised streets. It was expected that about 3,000 arc lamps would be required upon the routes referred to, but the Council now says that no further steps shall be taken for the street lighting of Manchester with arc lamps, and the Gas Committee is to have the benefit of the revenue to be derived from this source. A scheme is therefore being matured for the hiring-out of motors, arc lamps, and any apparatus connected with the use of electricity, to private consumers; and it is also suggested that a reduction in the price charged for these purpose should be made. This would increase the demand for energy and bring all the plant into use.

The energy sold during the year ending March 31st last in Manchester amounted to 10,502,299 units. These are the last figures available. The borrowing powers of the department amount to £2,171,121, and it supplies, in addition to the Manchester area, seven outlying districts, whose provisional orders this Corporation has taken over. The total revenue from lighting and tramways together, was £134,103. The maximum demand for electricity during the period referred to was 9,140 kw. There were only three small tramway routes opened; since then fresh routes have been completed and opened, and the Committee estimates that when the whole tramway scheme is working, the requirement will amount to 20 million units per annum for that purpose alone. Of the 9,140 kw. above mentioned, as the demand for the year ending March last, 7,930 were for lighting, and 1,210 for traction. The tramways department is being charged at cost price for energy, so that any surplus it hands over in aid of the rates, should be equally credited to the electricity undertaking.

Romford.—Negotiations are taking place between the U.D.C. and the Electric Light and Power Co., for the provision of electric light and tramways for the town.

Ross.—Both the gas and the electric light companies have offered to erect, free of cost, lamps for trial purposes, and the latter offers to provide arc lamps giving 1,500 hours' light for £19 10s., with £1 2s. 6d. for each 100 hours extra. Both offers have been accepted.

Runcorn.—The B. of T. has drawn the attention of the U.D.C. to the fact that nothing has been done by the Council under the E.L. order granted in 1899, and it now devolves upon the Board to determine whether the order shall be allowed to remain in force any longer.

St. Albans.—An electric lighting company is negotiating with the T.C. for the leasing of the Council's prov. order for electric lighting.

St. Helens.—The Electric Light Committee has instructed the town clerk to apply to the L.G.B. for sanction to the borrowing of the sums of £5,600 for extensions of mains, overhead work, &c., and £2,000 for the erection of a retaining wall, and the alteration of railway sidings at the power station, Cropper's Hill.

Cleckheaton.—The L.G.B. has sanctioned the borrowing of a further sum of £6,000 on electricity account.

St. Petersburg.—The British Consul-General in his annual report states that the business in electric fittings and installation is mostly in German hands, competition being rendered difficult by the low prices of the Germans, but it is considered that the trade in this branch has a good future, and British manufacturers should spare no effort to prove to the Russian purchaser the superiority of their productions in this particular industry.

Sheffield.—Last week there was a slight leakage of electricity from the Corporation lighting cables in the conduit below the pavement in High Street. The street was crowded at the time, and several pedestrians received shocks sufficient to make them wince, but nobody was hurt. The accident was due to a faulty cable, which was soon set right.

Sidmouth.—The U.D.C. on October 2nd decided that the Council should obtain its own prov. order, instead of allowing a private company to step in and obtain powers.

Somerset and District Electric Power Syndicate.—Messrs. Osborn, Ward & Vassall, of Bristol, have consented to act as local solicitors for this undertaking, and Mr. E. E. Smith, of 41, Broad Street, Bristol, has been appointed secretary *pro tem.* It is proposed to make an application to Parliament next November for an Act. It is hoped to supply energy in bulk at a rate which will compare favourably with the rate charged by other power schemes. The main generating station will be erected upon the Somerset coalfields somewhere in the neighbourhood of Radstock.

Spain.—Work has just been completed on the establishment of the central electric lighting and power station in the town of Zaragoza. It is expected that the new electric tramways will be ready for operation in a few days.

Tunbridge Wells.—A L.G.B. inquiry is to be held to-day with respect to the borrowing of an additional £10,000 for electricity works extensions, which have been occasioned by the continued growth of the undertaking. The number of consumers now on the register is 700, with 56,000 lamps.

Wallasey.—The U.D.C. on October 2nd adopted the recommendation of the Electricity and Tramways Committee that a loan of £51,210 should be applied for to extend the electricity works.

Wednesbury.—The General Purposes Committee has recommended the Corporation to supply electricity for private purposes in the borough only and on the basis of receiving electricity in bulk from the Midland Electric Power Co. The Committee has been negotiating with the company, who are prepared to supply electricity on the direct current system. The Committee recommends that application be made to the L.G.B. for sanction to a loan of £11,000, and also that instructions be given for the necessary plans and specifications, and for tenders for the necessary transforming plant, mains, &c. The Committee further recommends the Corporation to accept an agreement with the company for the supply of electric energy through a meter in the company's substation in the borough for both power and lighting purposes on the maximum demand system, on the basis of 3d. per unit for the maximum demand for one hour per day, and ·825d. per unit for the remaining hours, the company undertaking not to lay any distributing mains in the borough.

Yorkshire.—The Urban District Council's Association has decided to hold a conference of public bodies in Yorkshire to consider what joint action shall be taken with regard to the application of the Electrical Supply and Traction Co.'s application for powers to supply various districts in the county.

ELECTRIC TRACTION NOTES.

Allahabad.—*Indian Engineering* says that Messrs. Kilburn & Co., Calcutta, will shortly sign an agreement with the Allahabad municipality for the right to construct and maintain an electric tramway service in Allahabad. The length of the line for the present will be about 2¼ miles, beginning from the Chowk (the market of the city), and going to the end of Katra bazaar. The route is the main thoroughfare of Allahabad, from which branch off roads leading to all the principal offices and places of business, and the tramway should be a remunerative undertaking from its very start.

Belgium.—La Société Electricité et Hydraulique, of Liège, is building three 1,200-h.p. alternators for the tramway power station at Havre.

Birkenhead.—The first annual report on the working of the electric trams was presented to the T.C. on October 1st. This showed that the income was £31,593, and the expenditure, including interest and sinking fund, £28,079, leaving a net profit of £3,514, which had been transferred to the depreciation account. The receipts per car-mile were 10·54d., the working expenses 6·36d., and interest and sinking fund 3·01, showing a net profit of 1·17d. per car-mile. This profit, it was added, was equal to 11·12 per cent. of the income. It is estimated that during the current year there will be a surplus of £5,000 or £4,000.

Blackpool.—A motorcarist correspondent writes:—"While Blackpool has one of the best electric tramway services in the country, a visit to this popular seaside resort shows that the track is in anything but a satisfactory condition, and is in many cases positively dangerous to other vehicular traffic, and especially to cyclists. Some laxity is also noticeable with regard to the display of the fares charged. While on a visit to Blackpool I boarded a car the other day, for a journey the fare for which according to the *only* notice displayed on the car was 1d. The conductor demanded 2d., and explained that the list of fares shown were those which were to come into force a couple of days later!"

Bradford.—A curious development of the tramway dispute occurred on Wednesday last week. After the men's organisers had issued their ballot papers, Mr. C. J. Spencer, the manager, got out another series of ballot papers with the same questions on, and had ballot boxes placed in the Town Hall and tram sheds for their reception. His purpose was to get from the men direct, under the secrecy of the ballot, a true expression of their views on the question of a strike. On the previous evening the Trades Council had appointed a deputation to wait on the Tramway Committee to discuss the possibility of a settlement, and when it was seen that Mr. Spencer's ballot papers had been issued, the Trades Council representatives got into communication with the chairman of the Committee, and it was arranged that both sets of ballot papers should be collected and burnt the same evening, and the Committee and the Trades Council deputation should confer on the following day.

There having been signs that the chairman of the Tramways Committee (Mr. James Hill) is to be assailed in this month's election campaign on the score of the tramways management, the issue of returns of the department for the six months ending September 30th has been expedited. It is shown that the revenue for the half-year came to £89,500, being an increase of no less than £23,359 on the last previous half-year, a percentage of increase of 35·43. During the six months the fares on some of the lines have been reduced to scarcely more than half. A substantial surplus is shown on the working of the lines, amounting to £9,900 without allowing for depreciation, and £3,500 after deducting depreciation.

Brierley Hill.—The U.D.C. on Monday appointed Mr. R. P. Wilson, of London, as engineer of the light railway scheme.

Bulawayo.—The sub-committee appointed by the Town Council to consider the advisability of having an electric car line for Bulawayo has selected a route subject to the approval of the Council, and when the route is adopted it is proposed to call for tenders from persons willing to construct the tramway, in terms of the draft agreement which has been prepared.

Chatham.—The electric cars of the Chatham and District Light Railway Co. were well illuminated with coloured electric lamps on the occasion of Lord Kitchener's visit to Chatham on Saturday last.

Dartford.—Before embarking on an electric tramway scheme, the U.D.C. has decided to consult Mr. Hawtayne on the subject.

Devonport.—An electric car smashed up a trap that was crossing Fore Street on 6th inst., throwing the three occupants into the roadway; one of them had his skull badly fractured.

Doncaster.—The Doncaster Corporation has approved about half a dozen extensions of its routes, and will apply for loans for £11,000 for tramway and electrical purposes, and £3,000 for new cars.

Dudley and Stourbridge.—Colonel Von Donop held a B. of T. inspection on Thursday last week of an important extension which has been made of the Dudley, Stourbridge and District Electric Traction Co.'s lines by the construction at Stourbridge of a line two miles in length to Lye, and a line nearly a mile long, *vid* Enville Street to Wollaston. As a result of the inspection, Colonel Von Donop required some few alterations to be made which, a correspondent says, were expected to delay the opening of the line for about a week.

Durban.—The extension of the electric tram track is being pushed ahead, about 15¼ miles having been laid, or nearly two miles more than the original contract.

Eccles.—The opening of the line to Peel Green, on the 3rd inst., has placed the remoter parts of the borough of Eccles in communication with Manchester, by the Salford Tramway system to the boundary of the city. Horse traction has now finally disappeared from the Eccles tramways.

Farnworth.—The electricity undertaking seems to be working not very successfully. The district tramways are, in fact, showing a weekly loss, and the District Council is being urged by a local ratepayers' association to allow the Bolton Corporation to take over the whole system at an annual rental. Only by this means, it is said, will the Council be able to get a fair return for the capital it has expended. On the other hand, the Tramway Committee of Farnworth claims that the lines can be made to pay, and that time should be given for a proper test.

Flixton and Manchester.—A scheme for connecting Patricroft, Flixton and Urmston, on the Lancashire side of the Mersey, with Manchester by way of Stretford, Sale and Northenden, is being considered by the local authorities. The line will pass through a portion of the Bucklow Rural Council's district, which covers a very wide area, and the Council is being urged by local residents to give the project its strong support.

Johannesburg.—Mr. R. A. Dawbarn (of Messrs. Mordey & Dawbarn) has left for South Africa in connection with the electrification of the Johannesburg tramways.

Leigh.—The T.C. on October 1st decided to proceed immediately with its Bill for powers to construct branch lines of electric tramways within the borough, owing to the failure of the negotiations between the Corporation and the South Lancashire Tramways Co. It is proposed to construct and lease or work lines to Plank Lane, West Leigh, Hindley Green and Astley, radiating from the South Lancashire Co.'s trunk line which runs through the borough.

London.—We read that on the 2nd inst. the Marylebone Borough Council decided to refuse its assent to the construction of a surface contact electric tramway from the Marble Arch along Edgware Road to Cricklewood.

The L.C.C. on Tuesday adopted resolutions deciding to enter into an agreement with the South London Tramways Co. for the purchase of its undertaking which was authorised in 1882, and empowering the Highways Committee to conduct negotiations for the acquisition from the London and Deptford Tramway Co. of the lines sanctioned by the Southwark and Deptford Tramways Act, 1881.

London to Brighton.—The Hove T.C. has received from Mr. F. H. Cheesewright particulars of a fresh scheme for connecting the town and Brighton with London by means of an electric railway. It is proposed to construct the London end of the line from Waterloo to Croydon on a viaduct, and to run through Redhill, Horley, Hayward's Heath, to Brighton. Powers will be applied for to connect the line at Redhill with Reigate, and at Hayward's Heath with Lewes, by means of light railways.

Lourenço Marques.—The *African Argus* says that the Gorjao Wharf, at Delagoa Bay, is proceeding satisfactorily, all the necessary material being on the spot. It may not be generally known that this wharf will possess the most up-to-date crane plant in South Africa. The contracts have been signed for a large electrical generating station and a system of electrical cranes, the whole to be ready by February next. The cost is some £35,000, and the work is said to have been divided between Messrs. Siemens Bros. and Koppel, Ltd.

Middleton.—Last Saturday morning a collision took place between two workmen's electric cars, on the route between Middleton and Rhodes, near Manchester, on the Parkfield Loop. The cars were proceeding from opposite directions, and they both got on the same line, instead of one of them waiting on the loop. About 12 passengers were more or less injured.

The Manchester Corporation has informed the U.D.C. that the construction of the Middleton—Manchester electric tramway will be completed in about a month.

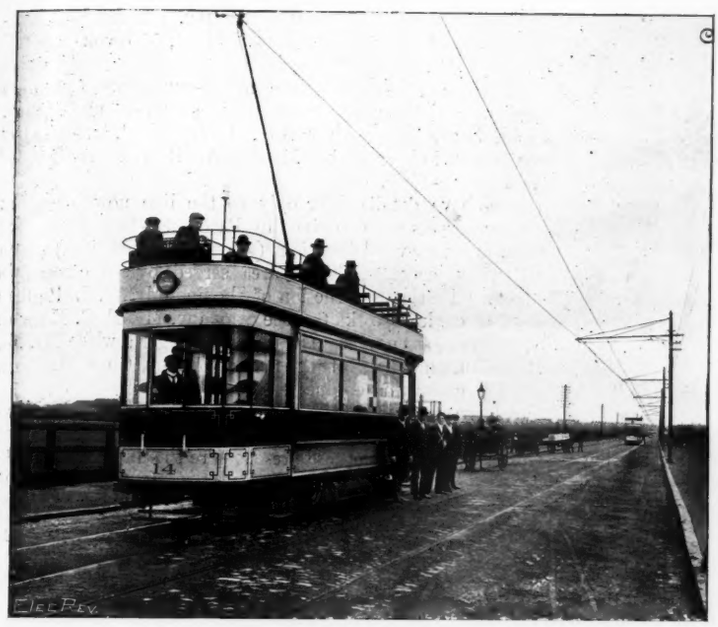
Newcastle-on-Tyne.—At a meeting of the City Council held on 1st inst. Mr. Cail, the chairman of the Tramways Committee, said that the returns for the previous week exceeded £3,000, and later stated that the expenditure was approximately £2,500 per week. The report of the Committee recommended the acceptance of the tender of the Lorain Steel Company for cross-overs and junctions in connection with the extension at Walker. The amount of the tender was £3,631, which was the lowest sent in, and was more favourable than any of the tenders sent in by any of the English firms. Another report recommended that application be made to the B. of T. for a prov. order to authorise the construction of a tramway from a junction with the Scotswood Road tramways, near the centre of Derwent Place, to the Clayton Street tramways. The junction would be a very great convenience, and would be of great utility in the working of the holiday traffic. Mr. Cail moved the adoption of the report, and said the cost would be between £3,000 and £4,000. Sir Charles Hamond suggested that the scheme should include the laying of a tramway from Clayton Street to Barras Bridge by way of Percy Street. He moved accordingly. Alderman Barker Ellis seconded. Mr. Cail thought the matter should be left to the Committee, who would not be slow in bringing forward new schemes. The report was adopted with the addition of Sir Charles's amendment.

A complimentary dinner was given on the 1st inst. at Newcastle, to Councillor William Cail, chairman of the Tramways Committee, in recognition of his services in connection with the institution of electric tramways in the city. In acknowledging the toast of his health, Councillor Cail said according to the latest returns the total expense averaged £2,450 a week, and as the receipts for the same time were £2,950 (this was based on the takings for the last four weeks), it showed a clear profit of £500 per week, or £25,000 a year. He hoped that at the present time the Committee would hand over those profits to a reserve fund or renewal fund. He did not think in the present state of the electrical science they would be justified in handing over to the relief of the rates money that in a few years might be required for development.

(Continued on page 627.)

TYNESIDE TRAMWAYS AND TRAMROADS.

On Monday last week, the new tramways and tramroads which have been constructed by the Tyneside Tramways and Tramroads Company, Limited, and which stretch from Gosforth to North Shields, a distance of nine route miles, were formally opened by Mrs. W. A. Watson-Armstrong, the wife of the chairman of the company. The function was one of considerable interest, for many reasons. In the first place, the tramroad, which stretches from Gosforth to the outskirts of Wallsend, is laid along a private enclosed way. The ceremony was also interesting, inasmuch as it brought very near to completion the series of tramways which will, in the course of a very short time, connect up the whole of the north bank of the Tyne, from Scotswood, on the West, to Tynemouth and Whitley on the East Coast. These systems will, when completed, total up to between 12 and 14 miles.



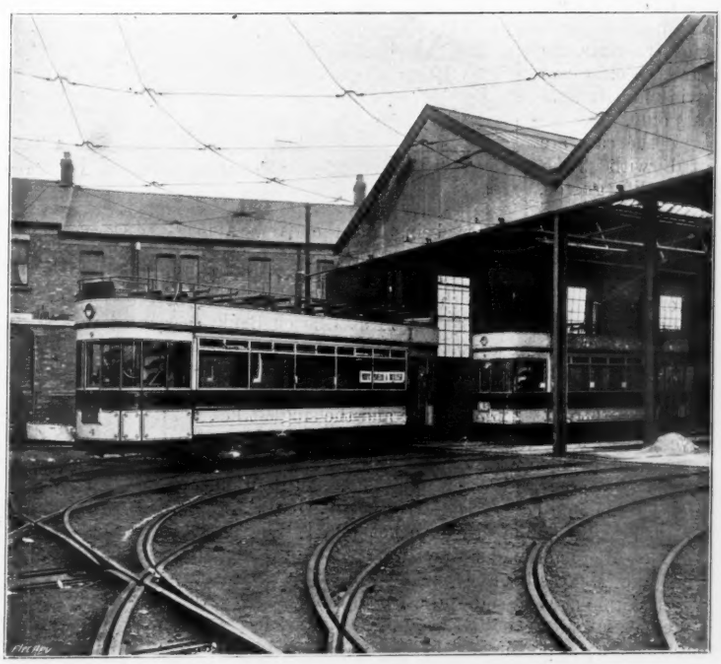
Cars on Howdon Road, North Shields.

The Tyneside tramways and tramroads gain their importance from the fact that the district through which they run is of great industrial importance, as some of the principal shipbuilding yards and engine works in the country are situated along the route, there being also a large resident population. The map on p. 624, shows the nature of the district, and the relative positions of the various manufactories and residential quarters, as well as the different lines which are now constructed, and those that are to be undertaken.

In the Tyneside system the tramroad, which runs from the residential quarter of Gosforth to Wallsend, is as mentioned above, constructed on land owned by the company, and as there is no other traffic, higher speeds are attainable than are permissible on ordinary tramways. It was also found that even allowing for the cost of the land, the capital expenditure is lower than in the case of a tramway, since it is possible to dispense with a concrete foundation and stone paving. A point of local interest in connection with the tramroad is that it follows the route of an old colliery wagon-way, formerly used for conveying coal from Coxlodge Pit to the river.

On this part of the line a special form of grooved rail with a high check has been adopted, as may be seen from the section shown on p. 625. These rails are laid on wooden sleepers, and the track is ballasted up to the tread in order to meet the Board of Trade requirements. The tramroad consists of a single track with passing places, which are located where the line crosses a public road, and at points where the speed would in any case have to be reduced. The tramway between Wallsend and North Shields, a considerable portion of which is double track, is of the usual construction, with foundations of 6 in. concrete. On a later page we give a section of the 95-lb. rail employed. The gauge is 4 ft. 8½ in., and the distance between the centres of the tracks 8 ft. 4 in. The entire length of track is just above 12 miles, single.

The overhead trolley wire, of 00 S.W.G., is of the special form illustrated on p. 625, which also shows the type of mechanical ear employed on the whole of the route, except at curves, where ordinary soldered ears are used. The perfect continuity of the lower surface of the wire obtained by this system of suspension enables the trolley to run much



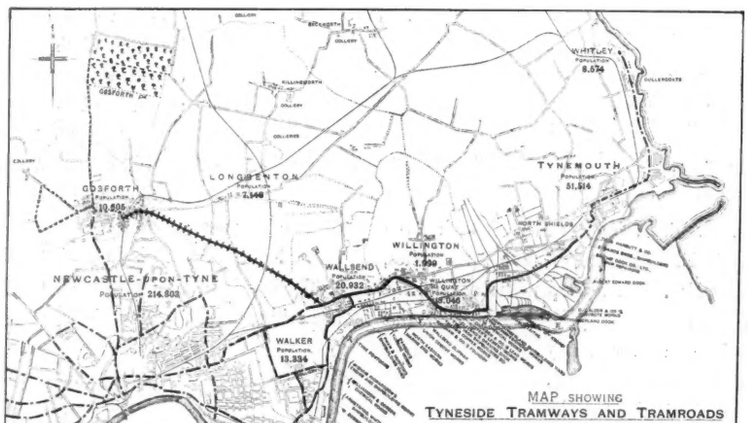
Bogie Car at Entrance of Car-Shed.

more smoothly than with soldered ears. The whole of the track and overhead equipment has been constructed by

Cutting at Gosforth, showing Tramroad Ballasted.

Messrs. Dick, Kerr & Co., Limited. The special work is of Messrs. Hadfield's manufacture, their manganese steel being used throughout.

The rolling stock at present consists of four bogie cars, each carrying 112 passengers, and 14 single-truck cars having a capacity for 80 passengers each. They are all of the double-deck type, with a completely enclosed vestibule at each end. The bogie cars are provided inside with combined longitudinal and transverse seats, the four-wheel cars having longitudinal seats only.



Map of Tyneside Tramways and Tramroads.

All the cars are fitted with Tidswell's life guards, and both hand and electric brakes, the latter being of the Newell magnetic type, the resistance in connection with which is used in winter as a car heater. The great power of the brakes is demonstrated in the ease with which the heavy cars can be pulled up on the gradient of 1 in 11 at Church Bank, near Wallsend. The bogie cars are provided with a four-motor equipment, each motor rated at 30 H.P. with a line pressure of 500 volts. The wheel base of the bogies is 4 ft., with 12 ft. 6 in. between bogie centres, and the single-truck cars have a wheel base of 6 ft. 6 in. Steel-tired wheels are used throughout. The car contract has been carried out by the British Westinghouse Electric and Manufacturing Company, the bodies having been supplied by Messrs. Geo. F. Milnes.

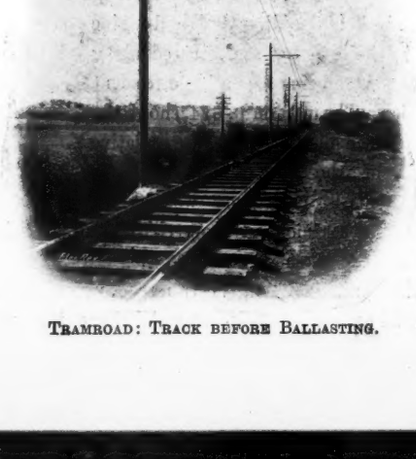
The Tramways Company have not found it necessary to build a power station, as they are able to obtain current from the Newcastle-on-Tyne Electric Supply Company's power station at Wallsend, and the Tynemouth Corporation's power house at North Shields. From the former station, electricity at a pressure of 5,500 volts three-phase and a frequency of 40 cycles per second, is transmitted by means of three-core paper-insulated cables to the various sub-stations, from which it is distributed for tramway purposes at a pressure of 500 volts, direct current. We reproduce an illustration (fig. 5) of the Gosforth sub-station, which not only supplies power for the tramways but also lights the district of Gosforth. The two small machines in the foreground are each of 75 KW. capacity, and are double-ended, supplying a 480-volt three-wire D.C. network.

The two larger machines are at present used for traction purposes only, although, when the lighting load increases, they will be used for this also, and further sets will be installed to supply the tramways. The capacity of each of these traction motor-generators is 500 KW. The synchronous motor is supplied direct with three-phase current at 6,000 volts, and runs at 300 R.P.M. The D.C. generator is compound wound for 500 volts at no load, 550 volts at full load.

In these sub-stations the motor-generators and high pressure switch gear have been supplied by Messrs. Richardsons, Westgarth & Co., of Hartlepool, and the low pressure switch gear by Messrs. A. Reyrolle & Co., of Hebburn-on-Tyne.

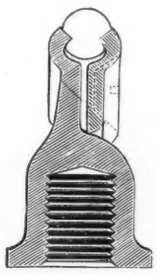
The above details refer only to the line now open, but further powers were obtained in Parliament last session for extensions in several directions (shown by dotted lines) which will widen considerably the area served by the company's system. In the construction of the line, Mr. W. L. Phillips acted as clerk of works for the company, Mr. F. C. Kidman being resident engineer and traffic manager; while Mr. W. McLellan, on behalf of the firm of Messrs. Chas. H. Merz, acted as consulting engineer.

A large gathering of ladies and gentlemen assembled at Newcastle on 29th ult., whence they were taken by special train to Gosforth. Amongst those present were the undermentioned: Mr. and Mrs. W. A. Watson-Armstrong, Dr. J. T. and Mrs. Merz, Mr. J. H. Armstrong, and Mr. Summers Hunter, all the gentleman named being directors of the company; Sir Benjamin Browne, Prof. Weighton, Dr. R. Spence Watson, the solicitor to the company, Mr. McLellan, Mr. F. C. Kidman, Mr. Little, acting secretary, and Mr. Phillips, officials of the company; Mr. J. S. Watson, manager of the Electric Supply Co.; Mr. C. Turnbull, engineer to the Tynemouth Corporation; Mr. A. B. Walker, manager of the Walker and Wallsend Supply Co.; and representing

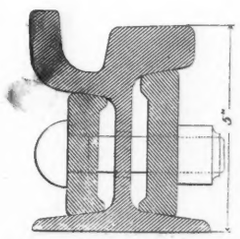


Tramroad: Track before Ballasting.

Messrs. Dick Kerr & Co., Messrs. John A. Hay, for the permanent way, and Sydney G. Redman, overhead equipment.

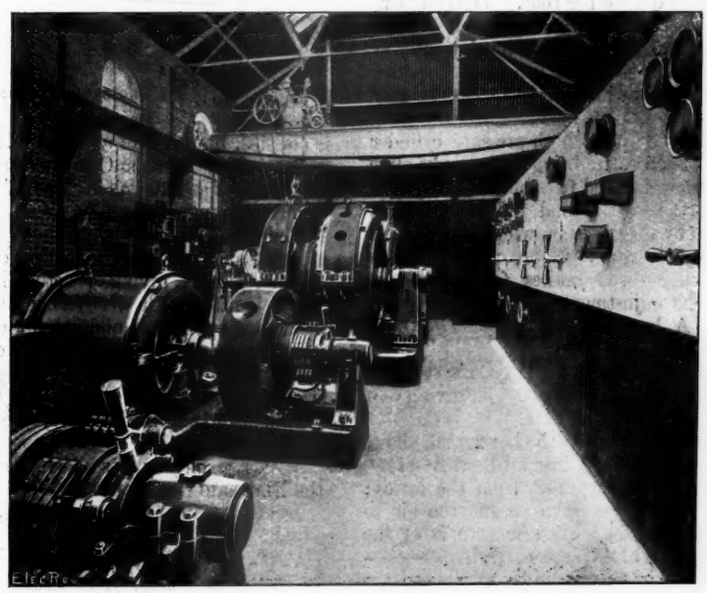


Cross-Section of Trolley Wire and Mechanical Ear.



Tramroad Rail; Cross-Section of Joint.

The tramcars were drawn up at Gosforth station and very neatly decorated. Mrs. Watson-Armstrong set the first car in motion, and the others to the number of five followed at short intervals. The trip was made under the most depressing weather conditions, but without the least hitch. The gradient is never heavy, with one exception, the Church Bank at Wallsend, but that was surmounted without the least difficulty; the descent of the bank was taken as an opportunity to test the power of the brakes, which acted admirably. The nine-mile run was covered in about 40 minutes, including stoppages. On the return journey the Wallsend sub-station was visited, and prior to luncheon at the car sheds at Wallsend, the Neptune Bank works of the Newcastle-on-Tyne Electric Supply Co. were visited.

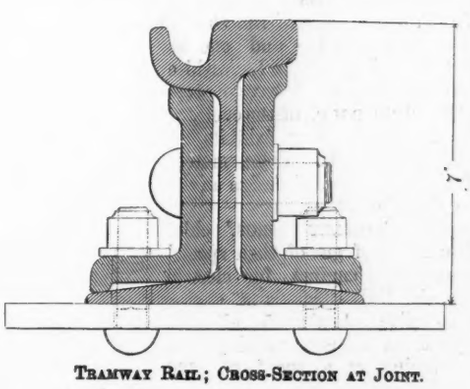


Sub-Station at Gosforth.

At the conclusion of the luncheon, after the usual loyal toasts, the chairman (Mr. Watson-Armstrong) gave the "Local Authorities," and said that not only the shareholders but also the public would benefit by the new means of locomotion which had been formally placed at their disposal that day. The authorities through whose districts the tramways passed were Gosforth District Council, Tynemouth Rural Council, the Corporation of Wallsend, the Urban District Councils of Willington Quay and North Shields, and the Corporation of Tynemouth, as well as the County Council of Northumberland. In the whole of the negotiations which had to be gone through before the Tramways became an established fact, the authorities had stood by them and helped them in their venture, and the company had always endeavoured to meet the wishes as far as was practicable of the local authorities, believing that their interests were largely coincident. The Act authorising the construction of the first part of the present system from Gosforth to North Shields obtained the Royal consent in the middle of August, 1901, and by November of the same year the the contracts had been let for the whole of the permanent way, for the cars and for the sheds, and arrangements were at once entered into for the supply of electricity by the Newcastle Electric Supply Co., the Walker and Wallsend United Gas Co., and the Tynemouth Corporation. The widening of Willington bridge threatened serious delay, and they had had to use a single line only, until the change was effected. The portion of line from Wallsend to North Shields had been open since September 4th, and they had been running a regular service of cars, although owing to the non-delivery of the cars, and the difficulty in regard to the bridge that he had mentioned, they had not been able to run so efficient a service of cars as they should have wished. Yet despite the fact that they could not run cars on Neptune Road, or Gosforth Road, could not cater for any traffic in the direction of Newcastle, and had no early morning cars, their receipts had been very satisfactory, and had fully realised their most sanguine expectations. The gap between their system and Newcastle would be filled up within twelve months by the Newcastle Corporation, and he hoped that as the results of the company's receipts between Willington and North Shields the Newcastle Corporation would at once see the financial desirability of establishing mutual running powers so that a through service to Newcastle would be expedited. They had entered into negotiations with the Tynemouth Tramway Co., whose gauge was, unfortunately, different from that of the Tyneside Co., for cheap transfer tickets. They hoped to open the Gosforth extension this year. In conclusion, he mentioned that the tramways were opened within eight months of the first breaking of the ground, which expedition was largely due to the energy, forethought and ability of Mr. McLellan, who, coming with a high reputation, had enhanced it.

Mr. Wm. Boyd, Mayor of Wallsend, responded to the toast, expressing his appreciation of the great value of the undertaking. He regarded municipal trading with great disfavour, and did not think any municipality could have achieved that which the company had done.

Dr. Spence Watson proposed a vote of thanks to Mrs. Watson-Armstrong for opening the tramways, and to Mr. Watson-Armstrong for presiding, and said he thought they saw in that extension of the tramways the solution of the housing of the poor problem.



Tramway Rail; Cross-Section at Joint.

Mrs. Watson-Armstrong, in her reply, said that as they were riding along in the cars that morning, she could not but contrast the luxury of the cars with the squalid houses and the narrow streets through which they passed, and she did hope that the tramways would be the means of enabling the workmen to find fresh fields where they could get bright and comfortable homes.

Mr. Watson-Armstrong having briefly replied, the function terminated, and the party returned to the city by special train.

THE WOLVERHAMPTON EXHIBITION.

(*Concluded from page* 573.)

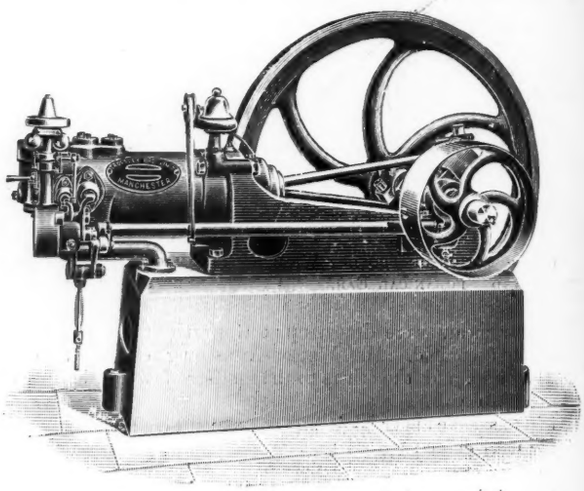
Messrs. W. Sisson & Co., of Gloucester, have one of their high-speed engines in the Power Department, coupled to a multipolar generator by the Lancashire Dynamo and Motor Co., Ltd., of Trafford Park; the set is shown in the accompanying illustration. The engine is of Messrs. Sisson's patent compound two-crank double-acting enclosed type, with automatic lubrication, patent automatic expansion governor, and self-adjusting connecting rods. The cylinders are 9½ in. and 15 in. in diameter, with a stroke of 9 in., and the engine gives 130 to 155 B.H.P. at 400 revolutions per minute. The Sisson engine is well known to our readers, who will find cross-sectional drawings of it in our issue of May 24th, 1901; the originality of its design renders it of more than ordinary interest. The high-pressure cylinder partly overlaps the low pressure, to bring the cranks close together and to reduce vibration and friction. Both piston valves are worked by one eccentric and rod, the lead and throw of which are varied by the governor, which is adjustable by hand while the engine is running. A very ingenious device keeps the connecting rod bushes (at both ends) exactly tight enough, the adjustment being automatically made every revolution. A large door gives ready access to the crank chamber.

The dynamo is of the Lancashire Dynamo Co.'s standard 6-pole type, suitable for light and power supply, giving 360 amperes at 250 volts.

The yoke is of cast-steel, divided in the horizontal plane. The field coils are former-wound, insulated with press-spahn and taped, the shunt coil separately from the series; they are supported in such a way as to permit the air to circulate freely inside and outside. The armature is of the slotted drum type, with ventilated core carried on a cast-iron sleeve, which extends from the outer bearing to the coupling, of which it forms part. The armature is wound with formed coils, held in place with wooden keys and steel wire bands. The commutator connections are flexible, to avoid breakage. The brush-holder gear is of specially substantial design, the holders being carried by a casting which supports the spindles at both ends; there are no screws in the brush holder which might work loose. The dynamo is guaranteed to stand an overload of 20 per cent. for two hours, and to rise in temperature in any part not more than 70° F. after six hours' run at full load.

Besides this dynamo and one at Messrs. Crossley's stand, the Lancashire Dynamo and Motor Co. have motors of 9, 13 and 20 B.H.P., of the enclosed ventilated type, driving exhibits at some of the stands. These motors are of the same general design as the dynamo described above.

Messrs. Crossley Bros.' chief exhibit consists of one of their special high-speed gas engines for electric lighting, size UE. This is an engine built to give about 45 effective horse-power as an easy working load when running at a speed of 220 revolutions per minute. It has a very sensitive high-speed electric light governor, and one exceptionally heavy fly-wheel, 8 ft. in diameter, which, on account of its weight, is supported on each side with suitable bearings. The crankshaft of the engine is fitted with heavy balance weights to reduce vibration. The engine is fitted with Crossley's patent double tube ignition, both tubes being in constant operation; should one give out, the work is continued by the other, and the faulty tube can be replaced without stopping the engine. At one end of the crankshaft

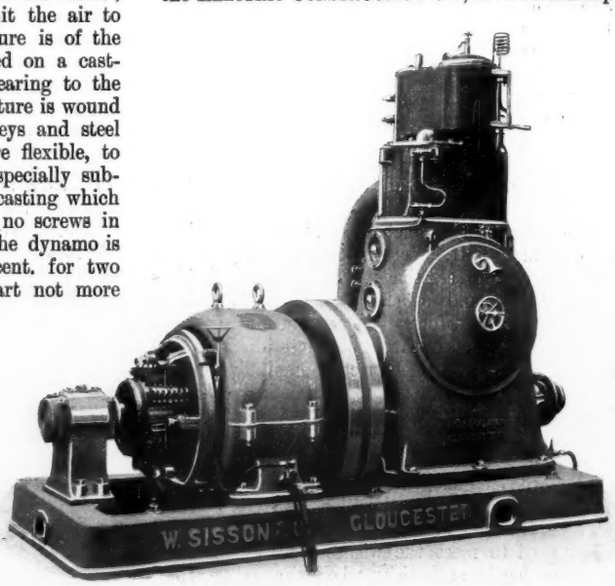


Crossley Gas Engine.

is coupled, by means of a patent "Raffard" elastic coupling, a Lancashire Dynamo Company's six-pole machine, giving 150 amperes at 220 volts. The whole forms an extremely compact arrangement.

The other engines consist of medium sized standard engines, and one of the smallest of Messrs. Crossley's gas engines, size H, giving ¾ actual horse-power. This little engine is fitted with a governor and all modern improvements and appliances, and is built on exactly the same lines as the larger engines. An M type engine, of about 7 actual horse-power, is exhibited, and one of the firm's medium sized oil engines, type 00, giving 7 actual horse-power. The workmanship and material are, of course, of Crossley's usual high standard.

We have already described the generators exhibited by the Electric Construction Co., of Wolverhampton, in the



Lancashire Dynamo Coupled to Sisson Engine.

power department; a direct-current transformer of the firm's manufacture is also in use, as a balancer on the three-wire system of the Exhibition. This machine is capable of dealing with an out-of-balance load of 200 amperes at 230—250 volts.

At the E.C.C. stand close by, a large and varied exhibit is shown. A small motor, made by the firm's predecessors, which has been at work for 20 years driving shafting, with no repairs beyond renewal of the commutator, is probably unique. In sharp contrast with this is the armature frame of a 1,600-KW. two-phase alternator, of which two have been supplied to the Leeds Corporation. The Highfield reversible booster, for which the firm has the sole manufacturing license (under the Chloride Electric Storage Syndicate, Ltd.) is represented by a machine rated at 230—450 amperes at 230 volts.

Numerous motors are shown, of various sizes and types; one of these, a 5-B.H.P. iron-clad "Bushbury" motor, is coupled to a three-throw plunger pump, by Messrs. Hayward, Tyler & Co. Another "Bushbury" motor is fitted with a Bodley worm gear, reducing the speed from 1,000 revolutions per minute to 50. There are several examples of the "Staffordshire" pattern, which the company has lately standardised, to meet the demand for multipolar machines, and the firm's polyphase motors, of powers from 2½ to 15 B.H.P., are well represented, with starting switches, transformers, &c. A rotary converter similar to several supplied to the Corporation of Halifax is shown. An extra-high pressure transformer, taking 350 volts on the primary and giving up to 40,000 volts on the secondary, has been arranged with a high pressure switch to give striking experiments with long arcs; another transformer, of 60 KW. capacity, is stated to have an efficiency of 98 per cent., with a voltage drop of 1 per cent. The whole forms probably the largest collection of exhibits shown in the Machinery Hall.

The SANDYCROFT FOUNDRY CO., LTD., exhibit an air compressor, with "Daw" patent balanced valve gear, driven by a four-pole semi-enclosed motor of 14 B.H.P., running at 500 revolutions per minute at 500 volts. A special type of enclosed liquid starting switch is used with this motor; this starter is provided with no-voltage and overload automatic release, and has been supplied by the company to several colliery and other installations. An air-driven rock drill—the "Little Hercules Baby"—for gold mining, &c., forms another exhibit, and to complete this class of machinery a model of an electrically-driven quartz crushing mill, with 10 stamps, is shown. An electro-magnet capable of lifting 1 ton, for use with a crane, is of interest; it is entirely iron-clad, of the company's own design, and is very useful for the rapid handling of iron or steel castings, plates, &c.

MESSRS. JOSEPH WRIGHT & CO., of Tipton, showed a number of the Excelsior, Simplex and other feed water heaters, filters, crane chains and hooks, and installed three feed water heaters of different types in connection with the steam generating plant of the Exhibition.

MESSRS. D. SELBY BIGGE & CO. showed a 200-H.P. dynamo, coupled to a vertical enclosed high-speed engine built by the Anderston Foundry Co., Ltd., of Glasgow. This engine, we believe, is practically the same as was exhibited at the Glasgow Exhibition last year, and which we illustrated in our issue of September 13th, 1901.

The dynamo is of the six-pole compound-wound type, runs at 400 revolutions per minute, and gives 670 amperes at 230 volts; it is capable of enduring an overload of 25 per cent. The combined plant has an efficiency of 82½ per cent.

Other exhibits of Messrs. Selby Bigge are a main switchboard, electric shipyard winch, and motors of various types. The winch has two winding drums, one capable of hauling two tons at 40 ft. per minute, the other 1½ tons at 60 ft. The motor has an efficiency of 92½ per cent.; it is of the series-wound type, the gear running in an oil bath. The whole exhibit illustrates a complete transmission plant from engine to arc and glow lamps and motors.

MESSRS. E. GREEN & SON, LTD., of Manchester and Wakefield, show one of their well-known economisers, of 192 tubes and 1,920 sq. ft. of heating surface, suitable for a pressure of 200 lbs. per sq. in. Actual tests on these tubes have resulted in their bursting at 3,136 and 3,360 lbs. per sq. in.

MESSRS. J. RHODES & SONS, of Wakefield, have a large exhibit of power presses for punching and stamping sheet metals. A special feature of these is their safety clutch, giving a single stroke when desired with absolute certainty. The edges of the dies are specially shaped to withstand hard wear, and are easy to renew, and the materials employed throughout are of the highest quality.

The stand of the New Brotherton Tube Co., Ltd., is composed entirely of the firm's "Excelsior" enamelled steel tubes and fittings for electric wiring.

An interesting exhibit is the Dürr boiler, installed by MR. JOHN THOMPSON, of Wolverhampton, in the boiler plant of the Exhibition. As is well known, this is based upon the Field tube principle, having inclined water tubes joined at one end only to the steam drum. Inner tubes of thin sheet-iron, concentric with the outer tubes, and opening into a separate part of the header, provide for circulation. To illustrate this construction, a section of one of the actual tubes is exhibited.

Messrs. Babcock & Wilcox, Ltd., have supplied one of their well-known boilers, fitted with their feed-water purifier and chain grate stoker; and Messrs. Edwin Danks & Co. (Oldbury), Ltd., have two of their "Cahall" vertical water-tube boilers in operation.

ELECTRIC TRACTION NOTES.

(*Continued from page* 622.)

Oldham.—The T.C. decided to rescind a resolution passed on April 2nd authorising application to the B. of T. for power to borrow £57,862 for certain tramway purposes, and in lieu thereof passed a resolution applying for £38,279 9s. 9d. to cover expenditure on tools, plants, &c., used in the construction of the tramways and for the erection of car depôts in Neville Street, Glodwick Road, and Copsler Hill Road, and for £26,010 13s. 1d. to cover the extra cost of the reconstruction of the permanent way in connection with the tramways existing at the passing of the Oldham Corporation Act, 1899, in consequence of laying down double track in lieu of single track as originally intended, and also of the provision of extra span-wire standards and electrical equipment.

The Corporation Tramway system is being rapidly extended. Several new lines, including the Ripponden Road and the Henshaw Street and Chadderton section, have been completed and will be opened for traffic immediately. The Featherston Road and Union Street section will probably be ready for opening by the end of the year.

At the last meeting of the T.C. a statement was made by the chairman of the Tramways Committee (Alderman Chadwick) with regard to the finances of the tramway undertaking. Over 196,000 passengers represented a normal week's traffic. They were running more cars, carrying more passengers, and, with the developments at the electricity station, they were practically reducing the amount they were paying per car for energy. Whereas the energy formerly cost £7 per week per car, it was now under £6. He hoped that at the end of the financial year he would be able to say they had wiped off their debit balances, and had prospects of making a good profit. They were losing money on two sections on every car run, and he trusted that the management would give these attention. The average number of cars on the system, working 16 hours per day, was 43, and the average earnings per car per week were £23. The working expenses and the cost of energy, taking the past eight weeks as the basis of calculation, were £723 per week, and interest amounted to £340, making a total expenditure per week of £1,063, whilst the earnings per week were approximately £1,000.

Peterborough.—The B.E.T. Co. was to have had its system of tramways at work at Peterborough by this time, but the works are far from complete, and it will be at least a couple of months before the first section will be in working order. The T.C., which is supplying the motive power, has just put down a special plant under the direction of its electrical engineer (Mr. Gill, C.E.). Under the agreement with the B.E.T. Co., the T.C. has the option of using the trolley wire columns for electric lighting purposes.

Rochdale.—The T.C. on October 2nd decided to serve the necessary notices on the Tramway Co. for the purchase of its undertaking.

Rotherham.—The relative qualities of basic and acid steel for tramway lines and fishplates were again discussed at length at the meeting of the T.C. on October 1st. Mr. Hirst, in moving that the rails and plates being delivered should undergo bending, tensile and chemical tests, stated that although Prof. Kennedy, who had sanctioned the substitution of basic for acid steel, said that the cost and quality of each were about the same steel manufacturers of Sheffield and Rotherham expressed the opinion that basic rails would not wear so well and were much cheaper than those made by the acid process. His opinion was that the difference in cost was 10s. per ton. Mr. Jenkinson, in seconding, drew attention to the fact that the Tramway Committee of Sheffield Town Council on April 15th last, after recommending the purchase

of 200 tons of basic steel rails at £6 15s. per ton, decided to purchase 1,000 tons of basic steel rails from the Barrow Hematite Co. at £7 7s. 6d. per ton. Applying these prices to Rotherham, where 1,300 tons would be required the difference would amount to £812 10s.; the difference, however, between the Rotherham contract price of £7 11s. 3d. and that of £6 15s. at Sheffield, was 16s. 3d. per ton, or a total of £1,056 5s. The Mayor (Alderman Winter) said he had the utmost possible confidence in the integrity and ability of the consulting engineers, Messrs. Kennedy and Jenkins. He had most excellent authority for stating that there was no difference whatever between basic and acid steel when used for railway purposes; for boiler plates basic steel might not be so good. The difference in cost which had been referred to was largely owing to the use of the Dicker joint, which was specified in the contract. The motion to have the rails and fishplates tested was carried by 11 votes to 9.

Selby.—The Riccall and Escrick R.D.C.'s have appointed a Joint Committee to carry out the construction of a light railway from Selby to Stamford Bridge, which was sanctioned in July last. The line must be completed in three years.

South Shields.—In connection with the preparation of the new Bill to be promoted in the next session of Parliament for the construction of electric tramways in South Shields, a northern correspondent states that he has it on good authority that a compromise has been arrived at as to the question of municipalisation, which has been a very vexed one since the matter was first taken up. The present arrangement is that the Town Council will first of all advertise for tenders from private companies to run the cars and then submit the highest of those tenders to the public for their decision as to whether they will accept the offer of the private company or prefer that the Corporation should run the cars themselves. It is stated that the Committee arrived at this resolve unanimously. At the meeting of the Council on the 1st inst, Alderman Lawson asked that that part of the report of the Parliamentary Committee on the Bill should be deferred until the Committee had completed its work, as the matter was now under the consideration of the town clerk and their legal advisers. This course was agreed to.

Southampton.—The T.C. has decided to apply for a loan of £7,310 for the construction and equipment of an electric tramway to Brook Inn, Hampton Park.

Steyning West.—The R.D.C. has decided to sanction the scheme of the tramway company for that portion of the Hove—Worthing electric tramway running through the Council's district from Kingston-by-Sea to Lancing.

Stourbridge.—At a meeting of the Council last week, a letter was read from the Dudley, Stourbridge and District Electric Traction Co., relative to the application of the Council to run through tram cars between Stourbridge and Kingswinford; and the company stated that owing to the restrictions the Council had imposed on the traffic through High Street, Stourbridge, the company could not see their way to run the through cars as had been suggested. The letter was referred to the Railway Committee for consideration, Mr. Haskew remarking on the inconvenience to the public in having to change cars at Brettell Lane.

Tipton.—The B. of T. having asked the U.D.C. for its observations in respect to the application of the B.E.T. Co. for the renewal of the license to use steam power on the South Staffordshire tramways for a further 12 months, the Council has decided to recommend that the license should be renewed for six months only.

It was reported at the meeting of the U.D.C. on September 30th, that the reconstruction of the tramway from Dudley to West Bromwich for electric traction would shortly be commenced, and would probably be completed in three or four months.

Torquay.—The T.C. last week discussed at great length the question of providing electric trams for the town. The Electric Lighting Committee recommended that when the expenditure on the first section constructed amounted to £50,000 for tracks and equipment, but not including power station, no further outlay should be made in respect of the other section scheduled in the Bill, until it was ascertained that the outlay was remunerative. The estimate for constructing 12 routes (8 miles 710 yards) was stated by the electrical engineer (Mr. P. Storey) to be £69,285, and an approximate estimate of working five miles, to cost £50,000 with cars, showed a loss of £109 per year. By 16 votes to 10 the whole question was referred to a committee.

The Power and Traction Co. has offered to enter into an agreement with the T.C. to construct and work the tramways under the Council's order, guaranteeing the interest and sinking funds, and sharing the profits. The Council has replied that if they decide to lease the tramways to a company, the Power and Traction Co. will have an opportunity of submitting an offer.

Truro.—It is proposed to construct an electric tramway from Truro railway station to Malpas. The line will be 2 miles in length, and will run along the banks of the River Fal.

Tube Ventilation.—According to the *Daily Chronicle* an extensive scheme for the complete ventilation of the tunnels of the Central London Railway has been prepared by Sir Benjamin Baker, the company's consulting engineer. The scheme, it is understood, provides among other things for the placing of air pipes through the entire length of the tunnels and the laying down of a special pumping plant at the generating station at Shepherd's Bush.

West Bromwich.—The T.C. on October 1st decided to recommend the B. of T. to renew the license of the South Staffordshire Tramways Co. for the use of steam cars for only three months in view of the probability of the system of electric traction in the borough being completed within that period.

Wolverhampton.—Our correspondent says that soon after 10 o'clock on Saturday evening, the whole of the electric tramcars were suddenly brought to a standstill. It appears that at the generating station of the Corporation two of the suction pipes connected with the pumps became clogged, and consequently the steam power went down to such an extent, that the electric current could not be maintained. It was after midnight before the current was restored, and since then the cars have been working without any hitch. It is stated that, it being Saturday night, the traction storage battery had been partially discharged during the heavy load to relieve the engines somewhat, and when it was called upon to take the whole tram service, it ran out in a few minutes. No private lighting was affected by the collapse, the lighting storage battery taking the whole of the work without mishap.

Yarmouth.—It is said that the financial results of the first quarter's working of the electric tramways show receipts £4,100, and surplus £2,125, presumably without considering interest, sinking fund, and depreciation.

Yeadon.—Choosing between the schemes of Messrs. Le Maitre & Parker, and Messrs. Dick, Kerr & Co., for the Leeds to Guiseley tramway, the Yeadon District Council has decided unanimously to give its support to that of the first-named firm.

TELEGRAPH AND TELEPHONE NOTES

Durban Telephones.—"Acting upon the report of the borough electrical engineer, the committee of the Durban Corporation appointed to consider his recommendations lately brought up a report that they be approved so far as forwarding indents for cables, poles and overhead wires, and the equipment of the exchange, and sanctioned the proposal that the Telegraph Manufacturing (Colonial) Co., Ltd., the Western Electric Co., Ltd., and the Ericsson Co. be invited to forward particulars and prices. When the report came before the Corporation it was referred back to the whole Council in committee for further consideration, the Mayor remarking that the total cost would amount to £80,000. In the meantime, the Government and Corporation have come to loggerheads, as it would seem that the former, who originally desired to obtain control of the telephone system of the Colony, have in hand a project for establishing an exchange of their own at the Point to connect all Government departments and military and transport offices, and later on Maritzburg and all other Government departments in the Colony. The two schemes are quite unnecessary, and if the Government persevere with theirs it will have the effect of seriously interfering with the Corporation system."—*British and South African Export Gazette.*

Hendon Telephones.—Over two years ago the National Telephone Co. obtained the names of a considerable number of probable subscribers. A house was bought for a telephone exchange, but now the company state that they are unable to carry out the orders and refer the intending subscribers to the G.P.O. The latter expect to make connection with Hendon in two years.

London Telephones.—As an outcome of the dispute between the Battersea Borough Council and the Postmaster-General respecting the proposed connecting of the Post Office telephone exchange system with that of the National Telephone Co., a conference of London Borough Councils was held at the Town Hall, Battersea, on Tuesday. Twenty-seven London public bodies were invited to send delegates, but only about 12 delegates attended. The conference elected delegates to form a deputation to wait on the Postmaster-General.

Manchester Telephones.—A municipal telephone service, on lines similar to those established in Glasgow, has long been desired by an influential section of the Manchester City Council. Some time ago a committee was appointed to consider by what arrangements the existing service could be improved. At a meeting held a few days ago by this committee, presided over by Alderman Southern, a resolution was proposed asking the City Council to open negotiations with the National Telephone Co., with a view to the acquisition of their undertaking in the Manchester area, and the establishment of a municipal service. The matter was fully discussed, and on a vote being taken the proposal was rejected.

The Pacific Cable.—Reuter's representative at Victoria (B.C.) telegraphed on Monday that the *Colonia* buoyed up the end of the Pacific cable one mile off Fanning Island at 11 o'clock that morning. "The total length of the cable is 3,445 miles, being 85 miles less than was anticipated." This marks the completion of the longest stretch of the new all-British Pacific cable, the total length of which is about 8,200 miles.

Portsmouth Telephones. — Although the formal opening of the Corporation telephone system will not take place until next month, everything is now ready. Up to the present time the completed area covers a large part of the borough. Most of the female operators who have been engaged have had experience of similar work on the N.T.C. and elsewhere.

Sheffield Telephones.—The Postmaster-General has intimated that he is willing to grant a telephone license to Sheffield T.C. on certain terms and conditions.

Submarine Cables in Warfare.—"We note that, according to some journals, a new war scare in England relates to the possibility of her submarine cables being cut in the shallow waters off the coast of Nova Scotia Evidences of British agitation on this subject have not fallen under our own observation, but the topic is an interesting one, and if it has not indeed been considered by the British Admiralty and military authorities, we should, indeed, be astounded. We are not so sure, however, that grappling for cable in the shallow waters off Nova Scotia is altogether the easy and pleasurable pastime depicted. It is said that a French man-of-war lay off the coast in 1899, ready to start cable cutting in case of war; but we surmise that there were one or two English cruisers around the corner. If we had cable cutting to do, we think our preference would be for the sunny Cuban coast and Spanish sharpshooting rather than the foggy banks and rocks of the upper North Atlantic. Besides, even when the coast is 'clear,' in more senses than one, we have known cable ships fitted with cabling appliances and expert crews waiting for weeks before they dared or could start operations for repairing cable or laying new sections. Hence, when it is urged that 'an ordinary sea-going tug would do the work within 24 hours, and within another day could have every one of them broken,' we must be excused if the opinion is offered that the suggestion did not come from a submarine cable engineer."—New York *Electrical World and Engineer.*

The Transmission of Telegrams.—The *Times* publishes the following account of a recent development in the London telegraph service, from a correspondent:—

A new and very important arrangement for the transmission of telegrams in the metropolitan area, which embraces the whole of Greater London, will shortly come into operation at the Central Telegraph Office. Hitherto it has been impossible for one outlying office within the metropolitan area to communicate direct with any other outlying office, no matter how long or short the distance, for no two offices had sufficient interchange of telegrams to justify the maintenance of an exclusive wire between them. Therefore, the transmission of a telegram from one office to another involved an intricacy of working which it is now hoped will entirely disappear. The problem of abolishing intermediate transmission has been continually under the consideration of the Post Office officials for many years. The system now being gradually introduced owes its inception to Mr. J. C. Lamb, the second secretary of the Post Office, who for a long time has been at the head of the telegraph department. It is a combination of an improved telephone switchboard and service signals with the existing Morse telegraphs. A few years ago Mr. Lamb saw something of the kind working in Belgium; in fact, even in England the switching of smaller offices on to main lines was in force when the Government took over the telegraphs in 1870, but as the traffic grew it was found to be too cumbersome, and was abolished. Recently Mr. Gavey, engineer-in chief, and Mr. Trenam, now controller of the Central Telegraph Office, accompanied by Mr. Purves, of the engineer-in-chief's department, made careful inquiries on the spot as to the possibilities of the Belgium system of intercommunication in relation to the metropolitan area, and, although the system as it existed was quite inadequate to the enormously larger traffic in London, it suggested the adaptation now about to be tried, the electrical and mechanical details of which have been worked out by Mr. Purves.

At present all messages from one part of London to another have to be retransmitted at the Central Telegraph Office. Under the new system this complicated work and consequent delay will be avoided. Each telegraph office in the metropolitan area will have a number. If an office, say, at Islington, has a message for Clapham, the operator at Islington will touch a special indicator key, on the top of which a white star will immediately appear. The touching of the key also lights a small glow lamp under Islington's number on the switchboard at the Central Telegraph Office. The operator at the switchboard inserts a plug, so as to connect with Islington, and that actuates the indicator key, and the white star disappears, thus informing the operator at Islington that his call is being answered. Then he replies by telegraphing the number of the Clapham office, and the Central operator, by switching on in the ordinary way, connects Islington and Clapham, and the message is thereupon transmitted direct from one office to the other. When the message has been transmitted, both offices depress their indicator key, which lights a clearing lamp at the Central office, when the operator at once disconnects.

It is intended to introduce this system gradually, and for the present only 138 offices, or about one-quarter of the total in the metropolitan area, are being included in the experiment. The whole system, it may be mentioned, will be worked by one set of accumulator batteries at the Central Office.

Wireless Telegraphy.—It was rumoured last week that the Marconi Co. had got a message through at Cape Breton from Cornwall station, but the company says that it has done no such thing, as its apparatus at Cape Breton is not yet completed.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900	
Trinidad-Demerara No. 1	Aug. 27, 1901	
St. Lucia-Grenada	May 8, 1902	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902	
Puerto Plata-Martinique	July 10, 1902	
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Gibraltar-Tangiers	Sept. 19, 1902	Oct. 4, 1902
Landlines:—		
Route *via* Hanekin on Persian territory	Feb. 24, 1900	
Communication with Tientsin and Taku *via* Hetampo	July 18, 1900	
Communication with Maranham	Sept. 19, 1202	

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—October 31st. Condensers for electricity works. See "Official Notices" to-day.

Barrow-in-Furness.—October 15th. Two batteries of accumulators, two boosters, switchboards, &c. See "Official Notices" September 26th.

Batley.—October 10th. 240 accumulator cells and accessories. See "Official Notices" September 26th.

Batley.—October 28th. Cooling tower and tank for the electricity works. See "Official Notices" to-day.

Belfast.—October 10th. Electric motors (12 months' supply) for the Corporation. See "Official Notices" Sept. 19th.

Blackpool.—October 15th. Coal-handling plant for the Corporation electricity works. Mr. C. Furness, Corporation electrical engineer.

Bootle.—October 14th. Tenders are wanted for wiring the refuse destructor (Pine Grove) for the Corporation. Specification, borough electricity works (one guinea).

Dudley.—October 18th. Arc lamp carbons. See "Official Notices" October 3rd.

Edinburgh.—October 13th. Electrical installation for the Stockbridge wash-houses for the Corporation. Specifications, &c., £1 1s., from the resident electrical engineer, Dewar Place.

G.W.Ry.—October 16th. Telegraph instruments and apparatus, electric lamps, carbons and other stores for the G.W.Ry. See "Official Notices" October 3rd.

Ipswich. — October 22nd. (*a*) Switchboard, motor boosters, and connections. (*b*) Overhead construction for tramways. See "Official Notices" September 26th.

London.—October 21st. Two electric car traversers for the L.C.C. tram depôts. Specifications, &c., at Spring Gardens, £2.

Paris.—October 27th. Competition for supply and installation of motors, pumps and generators for water-works. —Apply Hotel de Ville, Paris.

Rotherham.—October 16th. (*a*) Pipes, feed pump, economiser, &c.; (*b*) switchboard. See "Official Notices" September 26th.

Shanghai.—October 30th. (*a*) Two 500-kw. steam alternators; (*b*) switchboards; (*c*) two condensers and pumps. See "Official Notices" September 12th.

Spain.—October 19th. Tenders are being invited until the 19th inst. by the municipal authorities of Irun (Guipuzcoa province), for the concession for the electric lighting of the town. Tenders are to be sent to El Secretario del Ayuntamiento de Irun (Guipuzcoa), whence particulars may be obtained.

Spain.—October 20th. The municipal authorities of Bonillo (province of Albacete) are inviting tenders until the 20th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Bonillo (Albacete).

St. Petersburg.—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

Stalybridge.—October 13th. The Stalybridge, Hyde and Dukinfield Electricity Board invites tenders for Lancashire boilers, economisers, condenser and pumps, piping, crane, &c. See "Official Notices" September 19th.

Tien-Tsin. — November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

Wakefield.—October 18th. Electrical installation for the old workhouse buildings for the Guardians. Clerk, Union Offices. Specifications, one guinea.

Watford.—October 14th. Installation for Beech Grove Chapel. See "Official Notices" October 3rd.

Wigan.—October 20th. (*a*) Electrical equipment of a short length of new tramway and a portion of the existing line; (*b*) construction of same; (*c*) 18 bogie cars, double-deck, four motor. See "Official Notices" September 26th.

CLOSED.

Bury (Lancs.).—The T.C. has accepted the tender of the St. Helens Cable Company, for tramway feeder cables, and that of Mr. Jas. Brunton, of Hull, for constructing the permanent way on the Fairfield, Bolton Road, Heywood Street and Knowsley Street sections.

Clyde Valley.—It is reported that a contract to the value of half a million sterling has been placed with the Westinghouse Company, London, by the Clyde Valley Electrical Company, Glasgow, for the equipment of their two generating stations which are to supply electrical power for industrial purposes over an area of 755 square miles. The stations will be ready in about 18 months' time.

Gillingham.—The U.D.C. has decided to instal two 450-H.P. Willans engines, and one of smaller size, for direct coupling to dynamos by the British Thomson-Houston Co.

Huddersfield.—The T.C. has placed an order for low-pressure Dialite bitumen cables with the St. Helens Cable Co., Ltd.

Ladysmith.—Messrs. Hubert Davies & Spain's tender of £8,328 for lighting the town with electricity has been accepted, the whole work to be completed in eight months. The *B. and S.A. Export Gazette* says that the other tenders were:—

Siemens Bros. & Co. (incomplete tender)	—
Boult & Bradley	£13,880
Davey, Paxman & Co.	11,962
Blane & Co.	9,978
W. Hosken & Co.	9,036
S.A. General Electric Company	9,006
Reunert & Lenz	8,957
Collins & Kessler	8,880
Macartney, McElroy & Co., Ltd.	8,810
Silverton & Co.	8,750
Hamilton & Co.	8,417

London.—The London County Council on Tuesday had under consideration the following tenders for the supply of fuel economisers for the power station to be erected at Greenwich:—

	£	s.
E. Green & Son, Ltd., Manchester (accepted)	4,042	0
A. Lowcock, Ltd., Shrewsbury	4,053	0
Roberts Bros., Dukinfield	4,165	0
Goodbrand & Co., Stalybridge	4,286	10
The Clay Cross Co.	4,800	0

The successful firm will sub-let the contract for the motors for the economiser to the British Thomson-Houston Co.

Kingston-on-Thames.—The T.C. has accepted the following tenders for electricity works supplies:—British Electric Transformer Co. for sub-station switch fuseboards; Messrs. Prestwich & Burt, electrical engineers, Kingston-on-Thames, 30 patent locks for hoisting gear of arc lamps, £97 10s.; Gilbert Arc Lamp Co., 41 double carbon long-hour lamps, £369; 41 automatic change-over arc to incandescent switches, £143 10s.; 41 automatic cut-outs, £51 5s.; 41 main arc switches, £61 10s.; 40 special switches for hoisting gear, £25.

Peterborough.—Messrs. Crompton have received a further order from the Corporation for the supply of a dynamo for direct coupling to a 450-H.P. Willans engine for supplying power to the tramways.

Portsmouth.—Tenders for an electric lift, to be erected in Portsmouth Town Hall, were on Monday received by the Committee. They were four in number, but there was such a wide disparity in the figures that the chairman and vice-chairman were deputed to make inquiries and see two of the firms tendering, in order to inspect the class of work they propose to carry out.

Reading.—The T.C. on October 2nd accepted the tender of Messrs. R. W. Blackwell & Co., Ltd., for sections (A and B) of the electric tramways, at £13,477 3s

Salford.—The following tenders were accepted by the T.C. on October 2nd for supplies to the electricity works:—Messrs. Mather & Platt, Ltd., for two continuous current motors; British Westinghouse Co., for alternating current meters; Messrs. Baxendale and Co., for solder and plumber's metal, &c.; Mr. Gilbert Forrest, for frames and covers and joint boxes.

South Africa.—Messrs. Belliss & Morcom have just secured a contract for a 450-H.P. engine for coupling to a Mather and Platt dynamo. The same firm has also recently been favoured by the British Admiralty with repeat orders for electric light sets for the newest type of torpedo boat destroyer, a total of nearly 20 vessels in all.

Swansea.—The tender of the Horsfall Company, Leeds, at £9,000, has been accepted for the erection of a dust destructor.

The St. Helens Cable Co., Ltd., has secured orders from the Tramway Departments of Sheffield and Bury for large quantities of Dialite cable.

Worksop.—The U.D.C. has accepted the tender of Messrs. W. T. Glover & Co., Ltd., for electric cables, at £1,189.

FORTHCOMING EVENTS.

Friday, October 10th.—At 8 p.m., at Holborn Restaurant. Electro-Harmonic Society's first Smoking Concert for the new session.

Monday, October 13th.—Institute of Marine Engineers. "Standardising of Pipe Flanges and Flanged Fittings," by Mr. J. R. Ruthven.

NOTES.

Feed Waters.—A correspondent writes:—The statement on page 578 of the Electrical Review, October 3rd, 1902, with regard to well and river or lake waters must not be taken too generally. It is only locally that such a statement holds good; the reverse is probably the case quite as often. Well waters are not necessarily harder than the waters of a river or lake. Even in London, a well sunk into the chalk will produce water of a hardness about 6, or less than one-third that of the Thames, which flows over a chalk country. Generally, also, a well sunk into chalk which starts from the surface will supply water of considerable hardness, whereas a well sunk into chalk, where this is buried beneath the lower tertiary beds (*e.g.*, the London clay, Reading, Woolwich, and Thanet beds) will be soft. Again, surface waters are by no means so generally soft as is claimed, and shallow wells in the gravel of the London area are productive of very hard water. An example of a lake which is soft in quality is Lake Katrine, but it is soft simply because its waters are gathered over a surface of those old rocks which so generally do give soft water, not only in Scotland, but also in Cumberland and Wales; even much newer rocks, as the Millstone Grits of the Pennine Range, give waters fully as soft, as evidenced in the Longdendale water works of the City of Manchester. Borings into the same rocks will give equally soft water. On the other hand, the rivers of Derbyshire, more especially of the Peak district, are of so hard a nature that they will deposit lime salts in their course, probably because the spring waters which feed them lose their carbonic acid to some extent as their temperature rises. The shallow brewery wells of Burton-on-Trent are an example of shallow wells producing the hardest of waters. The truth is that hydro-geological conditions vary so rapidly over the face of these islands that every case must be considered by itself, and no general statement will bear criticism. It is, perhaps, not much known that perhaps the worst difficulty with some deep London wells is not lime salts but soda salts, which concentrate in a boiler for a long time without sediment, and require watching to prevent too dense a concentrate from forming. Locomotives, if properly worked, can be kept in better order as regards boilers than any other steam plant. After being fed with hard water until the scale becomes sufficiently troublesome, the engine can be sent to another district, or otherwise arranged to take water from another tank. The water from the second tank will clean out all the scale, and by these means boilers may be kept in order. Water from certain wells in the Wealden area will dissolve all the scale got from a chalk well. Geological conditions vary so quickly all over the British Isles, that there can be no standardisation and no generalisation. The water question depends so largely on geology, that the engineer might do worse than make geology a subject of study.

Fly-wheel Accident.—A fly-wheel at the Kelham Island power station of the Sheffield Corporation Electricity Works, burst on October 2nd, and a foreman fitter, named Chitty, was killed. A 35-H.P. engine which was being tested ran away, and the fly-wheel broke. At the time of the accident, Chitty was adjusting the governor.

Dustless Roads.—The experiment has been tried of oiling a piece of dusty road at Farnborough for the purpose of diminishing dust. It costs at the rate of £40 per mile. Ordinarily it is said to require £300 annually to keep up a mile of road. The question is, Will the use of oil enable this cost to be maintained as low? Probably it will. Oil rather points to waterproof conditions, and water is a sore destroyer of your ordinary road bed. Frost will probably cease to make mischief. It is said that dust has been entirely abolished even by the most philistine of motor cars. The amount of oil applied to a length of ¾ mile was 11½ tons of Texas oil. This amount is said not to be enough to damage india-rubber tires, but it converts the road surface into a substance like linoleum.

Peter and Paul.—A contemporary in the gas line, studying the B. of T. returns, points out that there were 63 electrical companies in the United Kingdom in 1900, with an aggregate capital expenditure of £10,954,188, and their total receipts for public lighting in that year were only £30,235. In the same year 165 local authorities, having a united capital of £14,943,122, drew £194,427 for public lighting. The inference drawn by our contemporary is that electricity is used for street lighting in order that municipal electricity may show a profit. The extra money which the ratepayers pay for the light appears in the balance-sheets as profits; *e.g.*, Worcester ratepayers in 1900 paid £200 less for street lighting by gas, but £1,583 more for electricity. The reasoning is ingenious; it fails, however, in one particular—that the "extra receipts" have an awkward habit of appearing in the balance-sheets as deficits. At Worcester the alleged profit—no reserve fund being formed—in 1900 was £4.

Will.—The will of Mr. Joseph Tangye, J.P., one of the founders of the Cornwall Engineering Works, Soho, Birmingham, who died on May 28th last, aged 75 years, shows that the estate has been valued at £13,116 gross, and £7,910 net.

Scholarship Awards.—The Clothworkers' Scholarship of £60 a year for three years, awarded on the results of the matriculation or entrance examination of the Central Technical College of the City and Guilds of London Institute, has been awarded to W. H. Grinsted from Horsham Grammar School, who obtained first place at the examination. Free studentships have been awarded by the Institute to W. M. Hooton from King's Lynn Municipal Technical School, L. G. Morse from Marlborough College, and H. K. B. Reed from the South-Western Polytechnic, who came next in order of merit.

Single-Phase Railroad in the States.—The greatest novelty in the equipment of the railroad between Baltimore, Washington and Annapolis will be the use of single-phase motors. How these are to be applied has not yet been given out.

The Quality of Commercial Carbide of Calcium.—A pamphlet has just been issued by the English Acetylene Association, a body which was formed early in the present year "for the advancement of acetylene engineering and manufacture in the interests of the public and of the industry," containing regulations as to calcium carbide, acetylene generators, and purifiers and purifying materials for use in conjunction with acetylene installations. The two latter sets of rules hardly concern us, although for the most part they seem well drawn up; but the regulations governing the merchantability and examination of carbide appear of sufficient merit and importance to be worth reproduction. They run as follows:—The carbide shall be guaranteed by the seller to yield when broken to standard size, *i.e.*, in lumps varying from 1 to 2·5 in. or larger, not less than 4·8 cub. ft. per lb. at a barometric pressure of 30 in. and temperature of 15·55° C. Carbide yielding less than 4·8 cub. ft. in the sizes given above shall be paid for in proportion to the gas yield, *i.e.*, the price to be paid shall bear the same relation to the contract price as the gas yield bears to 4·8 cub. ft. per lb. The customer shall have the right to refuse to take carbide yielding in the sizes mentioned above less than 4·2 cub. ft. per lb., and it shall lie, in case of refusal, and as from the date of the result of the analysis being made known to either party, at the risk and expense of the seller. The carbide shall not contain higher figures of impurities than shall from time to time be fixed by the Association. No guarantee shall be given for lots of less than 3 cwt., or for carbide crushed to smaller than the above sizes. In case of dispute as to quality, either the buyer or the seller shall have the right to have one unopened drum per ton of carbide, or part of a ton, sent for examination to one of the analysts appointed by the Association, and the result of the examination shall be held to apply to the whole of the consignment to which the drum belonged. A latitude of 5 per cent. shall be allowed for analysis; consequently, differences of 5 per cent. above or below the yields mentioned shall not be taken into consideration. Should the yield of gas be less than 4·8 cub. ft. less 5 per cent., the carriage of the carbide to and from the place of analysis, and the cost of the analysis shall be paid for by the seller. Should the yield be more than 4·8 cub. ft., less 5 per cent., the carriage and cost of analysis shall be borne by the buyer, who, in addition, shall pay an increase of price for the carbide proportionate to the gas yield above 4·8 cub. ft. plus 5 per cent. Carbide of 1 in. mesh and above shall not contain more than 5 per cent. of dust. The seller shall not be responsible for deterioration of quality caused by railway carriage in the United Kingdom, unless he has sold including carriage to the destination indicated by the buyer. Carbide destined for export shall, in case the buyer desires to have it tested, be sampled at the port of shipment, and the guarantee shall cease after shipment. The analyst shall take a sample of not less that 1 lb. each from the top, centre and bottom of the drum. The carbide shall be carefully broken up into small pieces, due care being taken to avoid exposure to the air as much as possible, carefully screened and tested for gas yield by decomposing it in water, previously thoroughly saturated by exposure to acetylene for a period of not less than 48 hours.

A Labour View of Electric Railway Traction.—In his report on railway wages to the annual general meeting of the Amalgamated Society of Railway Servants, Mr. Richard Bell, M.P., the general secretary of the Union, refers to the electrification of the North-Eastern, as follows:—"We all wish the companies to do well, for the more prosperous they are the more prosperous we hope to be. But their optimism is built upon economy, which, if not carefully watched, is not likely to benefit the workmen. We are on the eve of great changes in our railway system. Electric traction and automatic signalling will, undoubtedly, in the near future substitute much of the present system and methods. Many of the hints made by our leading railway chairmen are in this direction. The North-Eastern Co. have already decided to try electric traction between Newcastle and Tynemouth as an experiment, and several companies are experimenting with automatic signalling; and whilst electricity is developing nearly all the companies are constructing larger and more powerful locomotives by which they are able to reduce the train miles, in some instances, by one-half. The Great Northern and North-Eastern Companies have engines so powerful that one runs the Scotch expresses which formerly took two, and many companies have goods engines taking double the loads formerly hauled by one engine. This is economy which we cannot and ought not to resist further than is necessary to secure safety to and safeguard the interests of the workmen, inasmuch as it will, in many instances prevent the companies from having to increase their capital, for it is an acknowledged fact that British railways are already over-capitalised. It will relieve the congestion on the road, and the men ought to be worked less hours than at present as a result of trains being able to run straight away, instead of being shunted into sidings so frequently and being in each other's way. All these changes, I know, bring their advantages to the shareholders, and their disadvantages to the men. If improvements are to be encouraged, the advantages must be mutual. Larger locomotives and heavier loads in many ways increase very considerably the responsibilities of the men engaged in working the trains. The men, therefore, should be well organised at all times, and thus be prepared, with the present and prospective changes, to get their conditions re-arranged correspondingly, and only by the companies recognising the necessity and justice of this will the men be encouraged to continue to do their share for the prosperity of themselves and their employers."

Electrical Canal Towage.—The New York *Electrical World* says that recent developments in the use of electricity in respect to canal towage, which are being made in Europe, are attracting the attention of those connected with the canals of the Dominion of Canada. In Canada, the water-ways of which are to be greatly enlarged and extended in the near future, the application of electricity as a motive power for the vessels traversing them will necessarily be of the very first importance. The development of electric towage in Belgium is being watched with much interest. It is said that a scheme is now being considered for the establishment of an electric system of towage on the Rideau Canal, which terminates at the city of Ottawa on one end. It is claimed that there are no great difficulties in the way of operating such a system, abundant water-powers being available on all sides to furnish electricity. On the commercial canal routes of the Dominion, the adaptation of electricity to the needs of the traffic will, it is argued, not only lead to a saving in money, but will tend to conserve the canal banks, as the wash occasioned by propellers will cease to cause injury. It may not be long before electric power will be moving the barges on Canadian canals. A few months ago our contemporary gave the latest results of the work done in Belgium under the Gerard plan, using automobiles with three-phase motors, running along the ordinary towpath. There the work is associated with local light and power distribution. In the United States the adoption of electric canal traction lingers for some reason, although its feasibility has been pretty well demonstrated. From time to time such schemes as those referred to above are mentioned, and then they drop back into obscurity. The canal business is not, however, a very progressive one, and canals owned by the various States seem to be costly investments. But this might be urged as a reason for making a thorough trial of methods that would put the canals on a paying basis and prevent them from becoming obsolete pathways of commerce.

Lectures at the Arc Works, Chelmsford.—Messrs. Crompton & Co., Ltd., of Chelmsford, have arranged for courses of free lectures in their new lamp shop during the coming winter evenings. They are expressly for the benefit of the company's employés, pupils and apprentices, and with one exception the lecturers are members of the Arc Works staff. The lectures will bear as closely as possible on the work going on in the shops during the day, Messrs. Crompton's object being to give workmen, apprentices and others such theoretical instruction as will bear immediately on their daily work, assisting them to understand what they are doing and the reason for it. The illustrations will be drawn from actual work going on in the shops, and where possible will consist of samples of actual work rather than diagrams.

The first lecture was delivered on Monday last, and they will be continued on Mondays, Tuesdays and Fridays, until March next

excepting a month's vacation at Christmas. A number of awards for the "best note books" at the end of the courses will be given by Lieut.-Col. Crompton. The subjects to be dealt with are:—

"Steam Engineering," by Mr. W. H. Booth.

"Some Practical Details of Dynamo Design," by Mr. A Hutchings.

"Arc Lamps and Alternating Currents," by Mr. E. A. N. Pochin

"The Theory of Direct Currents of Electricity," by Mr. C. H. Wright.

We congratulate Messrs. Crompton upon this effort, and hope that it will result to the benefit both of the employers and the employés. If successful we understand that the lectures may be continued, and on a larger scale, in succeeding winters.

Shock Fatality.—The *Melbourne Age* records an accident which occurred at South Yarra in August, by which Alfred Wright, an employé of the Electric Light and Traction Company, met his death. He was fixing an insulator on a post, and continued to go on with his work after being advised that the current was being switched on. He was later seen lying across the wire, to which he was clinging with both hands. Realising that the unfortunate man had received a shock, a ladder was procured, and one of the workmen ascended and caught hold of Wright's clothing. As he did so Wright fell clear of the wire, and dropped head foremost on to the roadway 26 ft. below. He was picked up bleeding freely from extensive wounds on the head, and was taken to the surgery of Dr. Keogh, in Toorak Road, but was dead upon arrival. Examination showed that the man's skull was fractured, and that both hands were badly burned by contact with the live wire. The foreman states that deceased, who had been employed for eight months, had a habit of continuing work after the current was switched on. He was 26 years of age.

Lectures.—To-night (Friday) the first of a course of 10 University Extension lectures on "Electric Power and Lighting" will be delivered at Exeter Hall, Strand, by Mr. E. Halford Strange, M.Sc.

The Glasgow Tramway Engines. — Information relating to these continues to dribble out. Why mangled reports were published, with little bits to follow from time to time, we cannot understand. The first *apparently* complete report that we have yet seen appears in the *Light Railway and Tramway Journal* for 3rd inst. The following extract is additional to what we have already published:—

"There was some slight discrepancy between the figures for the electrical horse-power, as obtained (1) from the ampere and volt-meter readings; (2) from the indicating wattmeters; and (3) from the integrating wattmeters, after taking account of the corrections to be made upon the readings according to Messrs. Kelvin and White's tests of the instruments. On full consideration of all the conditions of the tests, I have taken, in the case of engine No. 3, the corrected readings of the indicating watt meters; and in the case of engine No. 4, the corrected readings of the ampere and volt-meters as being most correct."

The report is accompanied by the following editorial appendix:—

'In view of the criticisms which have been published in relation o the foregoing reports and tests, we have thought it desirable to invite Mr. Parshall's observations on the subject. They are as follows:—

"As regards the placing of the order, there were three bids higher than the E. P. Allis Co., but there was no firm who made the same guarantees as regards delivery. Delivery was the first point with the Glasgow Corporation. The Allis Co. delivered their engines in complete conformity with their contract. Messrs. Musgrave delivered theirs at about the time they intimated they would do so. As far as delivery is concerned, the performance is equally creditable to both Messrs. Musgrave and Allis, since Messrs. Musgrave had to build a new erecting shop.

"As regards practical performance, as far as I am able to judge, there is no particular difference between them; both classes of engines work perfectly well in every respect. They regulate well as regards speed, and run well in parallel; and the works cost of the Glasgow station shows the engines to be most economical. The consumption of coal is about 3 lbs. per Board of Trade unit, and the total works cost 2¾d.

"The engines built by Messrs. Musgrave were somewhat bigger and heavier than was called for in the specification. I think, however, Messrs. Musgrave were working in the right direction, since it appears that the friction loss in their engines is slightly less than in the Allis engines.

"The different steam consumption is easily accounted for, Messrs. Allis having put in bigger low-pressure cylinders than Messrs. Musgrave.

"As regards the accuracy of Prof. Barr's tests, in my judgment there is no doubt whatever. The generators were run on a water rheostat with power factor unity; the readings were taken with instruments freshly obtained from Lord Kelvin's laboratory, and the no-load, half-load, and full-load tests agreed closely with various tests which have been made by my own assistants from time o time.

"The combined efficiencies that have been contrasted with the efficiency of certain German engines were not higher than has been realised with other machines of the same type. It does not seem o me to be fair to Messrs. Allis or Musgrave to question the results because similar results have not been obtained on German-made sets.

"As far as I personally am concerned, it is a matter of indifference where engines come from. I have ordered a great many American engines, principally because in times past the conditions have been such that American manufacturers could deliver more promptly As things now stand there is nothing in American competition, since English manufacturers can supply what is wanted and in less time."

Mr. Parshall's letter will be read with great interest; it embodies several allusions to our recent critiques on the subject of Prof. Barr's tests. We note, with some surprise, that Mr. Parshall endorses the results, which have been communicated piecemeal to the public. We ourselves would gladly believe that a mechanical efficiency of 97 per cent. were possible—whether attained by American or British engines is immaterial, so long as justice is done to all. We have made no reference to German engines, but we presume that Mr. Parshall speaks of the Swiss Sülzer engines cited in our columns as the previous best on record: seeing that engineering progress rests mainly upon comparison between the latest results and the best previously attained, we consider our action perfectly legitimate. On the basis of the records, the alleged results of the Glasgow engines constitute an enormous advance, for which, in our opinion, the modifications in construction quite fail to account.

The last sentence of Mr. Parshall's letter is, we think, the most interesting of all, and forms a striking comment upon the statements which have appeared in American papers. The treatment which a previous letter received across the Atlantic was hardly calculated to enhance the esteem in which American manufacturers and journals are regarded in this country.

Obituary.—We regret to announce that Dr. J. H. Gladstone, Ph.D., D.Sc., F.R.S., passed away a few days ago at his London residence in his 76th year. For over 50 years he has been an ardent labourer in physical and chemical science, indeed as long ago as 1853, when only 23 years of ago, he was elected a member of the Royal Society, to whose proceedings, as well as those of the Chemical Society, he has been a generous contributor. That he was in scientific zeal until his days came to a close, will be gathered from the fact that he was present as usual at the Belfast meeting of the British Association only a month ago. The *Times* in its account of the distinguished scientist's career, says that "he belonged to a class of scientific worker which is nowhere so numerous as in this country, the class who, without being in the ordinary sense professional men of science, pursue scientific studies with professional ardour, devoting to them the leisure and the means which tempt other men to a life of amusement." For his optical and electrical researches, together with a vast amount of miscellaneous work, he received the Davy medal of the Royal Society a few years ago. For three years he was Fullerian Professor of Chemistry at the Royal Institution; he was the first president of the Physical Society in 1874; and president of the Chemical Society in 1877. It will interest some of our old-time readers to mention that a verbatim account of Dr. Gladstone's six Fullerian lectures on "The Voltaic Battery," at the Royal Institution appeared in this journal (then known as the *Telegraphic Journal*) during the first few months of 1875. His valuable researches on accumulators rank among his greatest achievements, and his work of this nature carried out in conjunction with Mr. Tribe, has been recorded in the columns of this journal. A funeral service takes place to-day at 2 p.m., at St. Peter's, Kensington Park Road.

The death has occurred, at the age of 47 years, of Mr. James Daniels Munn, of Birkenhead, who had for some time held a position in connection with the British Westinghouse Co., Manchester.

National Electrical Contractors' Association (Northern Section).—A meeting of the above Association was held at the Royal Station Hotel, York, on October 4th, when representatives of about 60 electrical contractors in the North of England were present. A scheme for the registration of workmen was adopted, and will shortly be in use. Questions relating to the training of apprentices, municipal trading, and standardisation of wiring rules and specifications were also discussed, and it was decided to hold the next meeting in Newcastle early in January.

Strike. — A serious strike of motormen has been in progress for some weeks past on the Hudson Valley Electric Railway, and several companies of militia have been called out.

Municipal Trading.—Extract from the *Northern Daily Telegraph* of 2nd inst.:—"Mr. J. Riley raised a laugh by saying that the members of the Corporation knew nothing about electricity, and that the only man who did was Mr. Birkett, the engineer. They had talked of kilowatts, but he would like to know what a kilowatt was. (Great laughter.)" Our sympathies are with Mr. Riley in his thirst for knowledge. But he is in good company—how many councillors know what a kilowatt is?

Personal.—Mr. S. Burton Edwards, the Lancashire representative of the Lahmeyer Electrical Co., Ltd., was married, at Eccles on 1st inst., to Miss C. J. Crompton, of Eccles.

A New York exchange says that Mr. Frank J. Sprague sailed for London at the end of September to spend abroad a few weeks of needed leisure following the important negotiations and changes connected with the acquisition of the Sprague Electric Co. by the General Electric Co., a purchase which includes also the Sprague multiple unit patents.

The Postmaster-General has appointed Mr. E. Trenam to be controller of the Central Telegraph Office, St. Martin's-le-Grand, in the place of Mr. E. May, superannuated.

Gloucester Dust Destructor. — The Corporation destructor was formally opened on Wednesday by the Mayor. It is a "twin cell" destructor by Messrs. Heenan & Froud, who quoted £4,150. Mr. Hammond, who has acted as consulting engineer for the electricity undertaking, described the works, which have a burning capacity of 50 tons per 24 hours.

Electro-Harmonic Society.—We would remind our readers of the first concert of the season, which is to be held to-night, and especially of the change of place to Holborn Restaurant.

Devonport Tramway Smash.—The fatality on this car system, to which we refer in our leader columns to-day, has resulted in the jury returning a verdict that the car ran away through ignorance on the part of the driver in not stopping at the necessary stopping places, and not subsequently using the proper appliances for stopping. They were unanimously of opinion that the instructions given to new drivers were not sufficient to make them competent for the duties they have to perform. The jury further recommended that the radius of the curve at which the accident occurred should be increased.

Appointments Vacant. — Assistant electrical and mechanical engineer for the Bethnal Green Infirmary; electrical engineer, at 400 rupees per month, for the Bombay, Baroda, and Central India Railway Co. See "Official Notices" to-day.

THE CENTRAL STATION ENGINEER.

The Croydon County Council has appointed Mr. H. C. Barkham, of Bedford, to the post of mains superintendent.

Mr. J. A. Crowther, of Leeds, has been appointed mains assistant at Bristol.

The Gloucester City Council has increased the salary of Mr. White, chief assistant at the electricity works, from £117 to £143 per annum.

The Heywood T.C., on October 2nd, appointed Mr. James Stott, chief assistant, to the post of borough electrical engineer, in succession to Mr. W. S. Johnston, who has been appointed engineer to Messrs. Veritys, Limited, electrical manufacturers, of Birmingham.

The Bedford T.C., on October 1st, confirmed the appointment of Mr. H. B. Jenkins as assistant electrical engineer, at a salary of £144.

The Darlington T.C., on October 2nd, adopted the recommendation of the Committee to increase the salary of the electrical engineer, Mr. Lunn, by £50 a year, without any restriction as to binding him to the Council's service for a stated period.

Mr. John Foster has resigned the position of gas and electrical engineer for the borough of Leigh, and the T.C. has decided to separate the management of the electricity department from that of the gas and water departments, and to appoint an electrical engineer at a salary of £156 per annum. When this decision was arrived at on September 30th, a motion to increase the salary offered to a commencing one of £200 was negatived by 15 votes to 6. Mr. D. M. Kinghorn has been appointed electrical engineer.

At Devonport Corporation Electricity Works on Saturday, Mr. H. E. Netten, draughtsman, was the recipient of a case of mathematical instruments from the staff and workmen, on his leaving to take up an important position under Messrs. Harland & Woolf, Belfast.

Mr. W. A. Turnbull, of Sunderland, has been appointed junior assistant at the Bury (Lancs.) Electricity Works, at a salary of 25s. per week.

The St. Helens T.C. has increased the salaries of the station superintendent (Mr. F. Dickinson) and mains superintendent (Mr. C. White) to £120 per annum.

The Dartford U.D.C. has increased the salary of the electrical engineer, Mr. A. J. C. Waterland, to £250 a year from July 5th last.

STEEL CASTINGS.

Steel castings are admittedly less easy to make than castings of iron. Their shrinkage is greater and more irregular; they suffer as much, or more, from sudden changes of section; they warp in cooling, are more apt to develop blemishes, and frequently contain many blow holes.

We believe this last difficulty is to be overcome by ample risers. All the foregoing faults were at one time held to be true and proper signs to know a steel casting by, and they have been tenaciously clung to by steel founders. Possibly it is convenient to have the engineering public remain under the false impression that steel castings must of necessity possess all these faults, otherwise they cannot be steel. If this be so, might we not just as well return to cast-iron, whose faults and worst weakness are known, as pay double price for so-called steel which cannot be guaranteed soft? Now, we hold that it is too late in the day to make any such ridiculous claims for steel castings. They can be made sound, and ought to be supplied sound.

The following clause is to be commended to steel founders. We take it from the Standard Specifications of American steel presented to a recent meeting of the American Society of Mechanical Engineers. It reads as follows:—

"13. Castings shall be true to pattern, free from blemishes, flaws, or shrinkage cracks. Bearing surfaces shall be solid, and no porosity shall be allowed in positions where the resistance and value of the casting for the purpose intended *will be seriously affected thereby.*"

We draw special attention to the latter portion of the above clause because, while it does not compel an impossible soundness, it does practically assert that unsoundness can be kept away from any part of a casting desired to be truly sound.

We fear that English steel founders have been too inattentive to their work, or we should not be so frequently hearing of, and seeing, foreign castings used by our manufacturing engineers because of their greater truth and freedom from blow-holes. If freedom from blow-holes does mean bad steel, let the fact be demonstrated without doubt by the purchase of foreign castings and the testing of their material. We are told that steel castings ought to be sound, or that they can be made sound at important *loci*, we presume, by suitable and sufficient heads. Of this we cannot, of course, speak as experts, but we do speak for the sake of English steel founders, who have before them a big trade if they will do it. Steel castings are used for heavy mill gears, they enter considerably into road engines, tramcar trucks and other important work where strength is necessary and malleable cast-iron is not thought good enough.

We believe that it is by attention to the chemistry of steel that success is to be reached, as well as by attention to the mechanical details of the foundrymen's art.

We are informed that much steel work, however, goes to the foreigner, and particularly to America, because of the lower wages there. Work that in America is done by advanced labourers is compulsorily to be done here by skilled moulders. As a result, it cannot be done here at all. The skilled moulder does not get it, but he deprives his poorer unskilled brother of the opportunity of earning better wages—an instance of man's inhumanity to man, and especially of trades union inhumanity, that we have previously pointed out as characteristic of union methods. The unskilled labourer, though quite usually superior in education and sobriety to his luckier brother man, is denied the opportunity of improving his pay, though by doing so he would not take any work now done in the country. Instances of this sort are constantly cropping up.

NEW COMPANY REGISTERED.

Nottinghamshire Electric Tramways, Ltd. (74,981).—This company was registered on September 29th, with a capital of £100 in £1 shares, to construct, maintain, and work tramways, light railways, electrical and other railways, motors for the same and their accessories and appurtenances, to apply for and obtain any powers, to manufacture and deal in cycles and motor and other vehicles, &c. The first subscribers (each with one share) are:—J. Likeman, Molland House, Sutton, director; I Harlick, 31, Hillfield Park, Muswell Hill, N., clerk; H. S. Kohler, Avnho House, Dalston, N.E., secretary; E. P. Perford, 50, Elmhurst Mansions, S.W., secretary; R. A. Goodman, Broad Street House, E.C., chartered accountant; J. Duff, 11, Hesaborough Street, S.W., secretary; and D. J. Norris, 13, Savernake Road, Hampstead, N.W., clerk. No initial public issue. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Edmundson's Electricity Corporation, Ltd. (52,013).—This company's annual return was filed on July 28th, when the entire capital of £40,000 in 50,000 ordinary, and 30,000 preference shares of £5 each had been taken up. £3 per share has been called up on 30,000 preference and 36,800 shares, resulting in the receipt of £334,000. £66,000 is considered as paid on 13,200 ordinary shares. Mortgages and charges, £180,000.

Century Engineering and Motor Co., Ltd.—Issue on September 24th of £500 debentures (10 of £50 each), part of a series created November 5th, 1900, to secure a total sum of £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series, £4,800.

La Capital Traction and Electric Co. (Buenos Ayres), Ltd.—An agreement dated July 19th, 1902, relating to a loan of £50,000, and (as collateral security thereto) a scrip certificate dated July 21st, 1902, for £75,000 debentures, have been registered. The certificate also states that James Capel & Co. are entitled to the benefit of an agreement of July 2nd, 1900. Property charged by the trust deed mentioned in said agreement and certificate: the undertaking and assets of the company, including shares in La Capital Co., of New York, La Capital Tramways Co., La Capital (Extensions) Tramways Co., Ltd., or the Cordoba Light and Power Co., of Maine, U.S.A. Persons entitled to the charge: James Capel & Co., Bankers, Bildon House, 7, 9 and 11 Moorgate Street, E.C.

Edisonia, Ltd. (phonograph makers, electric car manufacturers, telephone and telegraph makers, electrical novelty manufacturers, &c.) £5,100 debentures (five of £1,000 each), created August 29th, 1902, charged on the undertaking and all the property of the company, present and future, including uncalled capital, have been registered. No trustees. Persons entitled to the charge: The Edison-Bell Consolidated Phonograph Co., Ltd., 39, Charing Cross Road, W.C.

Thomas Parker, Ltd. (electrical and mechanical engineers, electricians, &c.)—Issue on September 29th of £500 debentures (five of £100 each) part of a series created June 23rd, 1898, to secure a total sum of £75,000, charged on the company's undertaking and property, present and future. No trustees. Total amount previously issued of same series, £68,900.

D.P. Battery Co., Ltd. (44,084).—The company's annual return was filed on July 21st, when the entire capital of £10,000 in shares of 4,992 "A", 4,995 "B" and 8 other shares of £1 each had been taken up and paid in full. Mortgages and charges, £20,000.

White, Jacoby & Co., Ltd. (52,494).—This company's annual return was filed on September 17th, when 2,207 shares were taken up out of a nominal capital of £4,000 in 4,000 shares of £1 each. £1 has been called up on 850 shares, resulting in the receipt of £850. 2,207 shares are considered as fully paid. Mortgages and charges, £1,500.

CITY NOTES.

Chilian Electric Tramway and Light Co.

The report for the year ended December 31st, 1901, states that the profit and loss account for the year, after payment of interest accruing on advances for construction, shows a balance to debit of £6,657. This amount deducted from the balance to the credit of profit and loss account carried forward from the year 1900, £9,959, leaves a net balance to the credit of profit and loss account to be carried forward to next year of the sum of £3,301. At the close of the year 1901 the reconstruction to electric traction had been nearly completed, and on February 28th of this year, the contractors finally withdrew from Santiago, and handed over what work remained to be done to the general manager for completion. During the year 1901, although progress was made in the development of the use of electric lighting amongst the inhabitants of Santiago, great opposition was experienced from the municipality. Under the terms of the company's concession, the municipality is compelled to take the company's electric current for the public lighting of the town. That body, however, endeavoured to evade this obligation, and the company was at length compelled in self-defence to submit its case to arbitration. The arbitrators decided in the company's favour in June of the current year in terms of an agreement already made with the municipality, by which, within a period of four years, this company is to provide a complete installation for the public lighting of Santiago. Meantime 334 arc lamps of 500 C.P. each are now in course of being installed in the central district of the town. The directors anticipate, therefore, that having now come to an amicable arrangement with the municipality, and the public also showing an increased desire to adopt the new illuminant, the returns for the current year will show a gradually increasing development.

Direct United States Cable Co.—Interim dividend 3s. per share (3 per cent. per annum) for the quarter ending September 30th, 1902.

Ibbotson Bros. & Co.—The annual meeting of this company will be held at Globe Steel Works, Alma Street, Sheffield, on Monday, October 10th, to adopt the directors' report, which recommends a total dividend for the year of 7½ per cent.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be quoted in the Official List:—Blackheath and Greenwich District Electric Light Co., Ltd.—£100,000 4½ per cent. first debenture stock, in lieu of the provisional certificates now quoted.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week.		Total to date.		Miles open.	
		Am'nt.	Inc. or dec.*	Am'nt.	Inc. or dec.*	This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Sept. 20	831	+ 58	22,065	+ 3,797	12½	19½
Blackpool and Fleetwood	Oct. 4	667	+ 3	18,098	— 443	7½	7½
Bristol Trys. & Car. Co.	,, 3	4,612	+323	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	Sept. 26	463	+ 58	16,871	+ 673	5	5
Dudley—Stourbridge..	,, 26	891	+ 67	29,254	+ 3,706	18½	18½
Gateshead	,, 26	899	+252	28,536	+ 5,095	10½	9½
Gravesend	,, 26	297	—	1,795	—	3½	—
Greenock—Pt. Glasgow	,, 26	498	+236	19,522	+11,778	7½	7½
Hartlepool	,, 26	277	— 2	10,065	+ 1,179	6½	4½
Kidderminster	,, 26	146	+ 14	4,915	+ 35	4½	4½
Merthyr	,, 26	229	— 16	7,879	— 1,432	3	3
Middleton	,, 26	298	—	8,354	—	8½	—
Oldham—Ashton ..	,, 26	571	+ 48	20,597	+ 1,012	8	8
Poole	,, 26	316	— 13	10,220	— 120	3½	3½
Potteries	,, 26	1,622	+194	56,778	+ 2,357	28½	28½
Rothesay.. ..	,, 26	118	— 22	1,988	+ 328	—	—
Southport	,, 26	294	+ 93	10,173	+ 3,598	5½	5½
South Staffordshire..	,, 26	762	—169	29,548	— 594	21½	23½
Swansea	,, 26	518	+ 80	18,488	+ 1,203	5½	5½
Taunton	,, 26	68	— 36	2 607	— 229	1½	—
Tynemouth	,, 26	987	+ 94	11,801	+ 1,431	3½	3½
Weston-super-Mare..	,, 24	154	—	4,981	—	2½	—
Wolverhampton Dist.	,, 26	315	+101	7,609	+ 4,986	10½	2½
Central London Railway	Oct. 4	6,902	+751	98,838	+ 7,694	6	6
City and S. London Ry.	,, 5	3,033	+1,002	89,277	+13,037	6½	4½
Doncaster Corp. Trys. ..	Sept. 27	—	—	1,546	—	5½	—
Dover Corporation Trys.	Oct. 4	209	— 34	8,993	+ 79	3	3
Dublin United Trys. ..	,, 3	4,588	+ 22	70,363	+ 732	46	46
East Ham Tramways ..	,, 4	485	+ 60	—	—	5	4½
Glasgow Corp. Trys. ..	,, 4	13,486	+302	219,024	— 9,826	57	48
Liverpool Overhead Ry.	,, 5	1,506	+ 66	24,310	— 1,250	6½	6½
Newcastle Corp. Trys. ..	,, 4	3 019	—	—	—	35	—
Sunderland Corp. Trys.	,, 5	1,050	— 18	—	—	17½	17½

* Compared with the corresponding period of 1901.

STOCKS AND SHARES.

Wednesday Evening.

Renewed borrowing in all quarters of the globe and the unsettled state of financial affairs in New York are combining to bar that restoration of tranquility to the money market without which it seems vain to hope for better business in the Stock Exchange. The new loans which are now with us take a subordinate rank, so far as interest is concerned, beside that issue of Transvaal Colony stock about which it is to be hoped that Parliament will have something to say when the House re-assembles next week. Not until this latter issue has been made can any improvement be looked for in the price of Consols, and of course the investment departments look to the funds to lead them in their courses. In regard to the sections devoted to electricity, the dulness of investment securities makes itself felt mainly in the shape of stopping business. Quotations are again mostly higher on the week, but the variations number no more than 16 in all, of which only a couple are on the fall side.

Declarations of the usual dividends by the two Far Eastern companies, the details of which appeared in our last issue, have had a strengthening influence in this department, although the only recordable change is a point rise in Eastern Telegraph Ordinary. Eastern Extensions have not recovered their slight fall, but Great Northern, of Copenhagen, are a sovereign higher, thanks to a small demand coupled with scarcity of shares in a limited market. Anglo-American descriptions fail to respond to the activity in the Yankee division, the dull tone of the latter counteracting whatever good influence might be otherwise derived from the good business now being secured by the various companies engaged. Nor is there any change to report in the Trust Co.'s shares. The dividend of 3s. on Direct United States has not affected the price of the shares.

Electricity supply issues are all steady, with the exception of Kensington & Knightsbridge Ordinary shares, which are 10s. easier. It is difficult to find any adequate explanation to account for the relapse, especially as several of the other London companies' securities show small advances. City of London Ordinary are marked up 10s., but actually the price is much the same as it was this time last week. Chelsea Ordinary have added ¼ to their quotation. In the gilt-edged list, almost the only change is a rise of 1 per cent. in Blackheath and Greenwich 4½ per cent. Debenture stock, following upon the better tone recently shown by the shares. Brush Electrical have steadied at their reduced quotation.

Flurry, succeeded by revival, has been occasioned in the Brighton Railway market by the publication last Saturday in the *Times* of details concerning the new scheme for running a rival electric service to London-by-the-Sea. Brief particulars were given in this column anent this same scheme a fortnight ago. The new adventure has met with a reception far from cordial, and apparently the market considers that the threatened line will not damage the older company to any extent, for the price of Berthas has recovered from its fall. Of course the directors of the Brighton Railway are, themselves, experimenting with electric traction, and there is even a hint that the company may adopt a mono-rail of its own, or work in conjunction with that other undertaking which set out to accomplish a separate mono-rail on its own account.

Central London issues have all been lifted a point each, and the fierce discussion raging between the advocates of the various tubes does not affect this market in the least. The Twopenny Tube traffics are good, but are surpassed considerably by those of the City and South London. It is somewhat singular that the stock of this last-named does not recover from its recent weakness, considering that the Royal Progress must take crowds of people over the City and South London's route, not only on the day of procession, but both before and afterwards. The company boasts a traffic increase to date of £13,037 against the £7,700 of the Central London, and both should do remarkably well by reason of the return of the King to London. No notice is taken of the scheme to run a competing line under the Twopenny Tube, branching off at the Marble Arch in the direction of Cricklewood.

Up to the present the alarmists have been good enough to spare us harrowing predictions as to what will happen to the railway, electric lighting and other companies concerned with the price of coal in view of the strike in Pennsylvania, but no doubt the prophecies will be making their appearance very shortly. It is something to have been allowed to rest in peace so far.

In the miscellaneous market, Crompton shares have got back to 2¾ again, and Edison "A," £3 paid, are nominally better. Telegraph Constructions came on offer the other day, and the price fell £1, while a seller of British Aluminium Preference was unable to dispose of his shares at even the quoted price of 3½. Amongst telephone issues, National First Preference are up ½, in continuation of the example set them last week by the Seconds. Oriental and Chili shares are both unaltered on the week. There is a good deal going on in British Westinghouse issues, and the Ordinary are now a shade over £7 a share. Reuter's shares have hardened a trifle through the broadening of the quotation. A circular sent out by the National Electric Traction Co. states that the amalgamation with the City and Surrey Railway is being "regularly carried out," and that a Stock Exchange quotation for the shares is to be applied for. We shall be rather curious to see at what price this undertaking's shares will be valued by its sponsors; outsiders have a very fair idea already.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Oct. 1st.	Closing Quotation Oct. 8th.	Business done during week ended Oct. 8th, 1902. Highest.	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3⅛— 4⅛	3⅛— 4⅛	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
788,840	Anglo-American Telegraph	Stock	73/6	3½%	61s.	47 — 50	47 — 50	48⅛	47⅛
3,105,580	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92⅛	91¼
3,105,580	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7¼— 7⅜	7¼— 7⅜	7⅛	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3¾— 4	3¾— 4	...	...
1,333,300$	Commercial Cable	$100	8 %	8 %	8 %	160 —170 xd	160 —170 xd	...	...
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	93 — 96 xd	93 — 96 xd	95⅞	94
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5½— 6½	5½— 6½	5⅝	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3¼xd	2½— 3¼xd	...	...
6,000	Do do. 10 % Cum. Pref.	5	...	...	...	7 — 8 xd	7 — 8 xd	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10¼— 11	10⅛— 11	10⅛	...
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
1,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	125 —130	128½	126
1,955,565	Do. 3½ % Pref. Stock	100	...	...	...	90 — 93	90 — 93	92½	90⅞
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 — 110	107 —110	108	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12 7/16	12 3/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —110	107 —110	...	...
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...		101 —104%	101 —104 %	101½	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9½— 10	9½— 10	9⅝	9½
180,042	Do. do. 6 % Pref.	10	...	...		13½— 13⅝	13½— 13⅝	13 11/16	13⅝
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	15 %	15 %	26 — 27	27 — 28	...	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	...	...
180,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	101 —105	101 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	⅞— 1	⅞— 1	...	...
1,383,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	93 — 95	93 — 95	94¼	93
1,966,667	Do Def. Stock	100	...	60	64 xd	55 — 57	55 — 57	56¼	56
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 13	12½ - 13½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½ - 12½	11½ - 12½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96½	...
600,000	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	103¼	102⅛
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	5 %	6½— 7	6½— 7⅛	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜— 5⅛	4⅜— 5⅛	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	102 —105	...	...
15,609	West African Telegraph, Shares	10	...	...	...	3½— 4⅛	3½— 4⅛	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Brzs. Sub. Tel.	100	...	...	...	98 —101	98 —101	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	11⅜— 12⅛	11⅜ - 12⅛	12⅛	11⅞
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
400,000	Do. do 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	...	...
68,821	West India and Panama Telegraph	10	⅛%	¼ %	...	¼— ⅜	¼— ⅜	5/16	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	4½— 5	4½ - 5	4⅝	4½
4,669	Do. do. do 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 4	3 — 4	...	...
90,000£	Do. do. do % Debs., Nos. 1 to 1,800	100	...	...	...	99 — 102	99 —102	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ½	⅜— ½	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106 xd	104 —107 xd	...	...
20,000	Brompton & Kensington Elec. Lt. Sup., Ord., 1 to 20,000	5	6 %	6 %	8 %	10½— 10⅝	10 - 10⅜	10 1/16	...
20,000	Do. do. 7 % Cum. Pref. ...	5	...	...	...	10½— 10⅝	10½ 10⅜	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9½	9 - 9½	...	...
70,000	Do. do do do 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	...
40,000	Do. do. "City Undertaking" 4½ % Cum. Pref.	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
250,000	Do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	105⅛	...
44,436	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5½— 5⅝	5½— 6	5½	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,595	City of London Electric Lighting, Ord. 40,001— 110,595...	10	4 %	0 %	5 %	9 — 10	9½ - 10½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½ - 13½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	105	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½ - 12½	11½ - 12½	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 —114	111 —114	...	...
50,000	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6 3/8	6⅜
30,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6½	...
140,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	107 —110	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½— 11½	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4½— 5	4½— 5	4⅝	4⅝
*50,000£	Do. do. do. 4 % 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 — 99	96 — 99	97½	...
100,000	Metropolitan Electric Supply, 1 to 100,000	10	5 %	6 %	6½%	15½— 16½	15½— 16½	15⅝	15⅜
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —115	110 —115	112	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	99 —102	99 —102	...	...
10,852	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½— 14½	13½— 14½	14½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	...	...
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3	2½— 3	...	...
110,000	Westminster Electric Supply, Ord.	5	12 %	10½%	10½%	11 — 12	11 — 12	11⅝	...
28,141	Do. do. 5 % Cum. Pref.	5	...	...	...	6 — 6½	6 6 — 6½	6½	...

* Subject to Founders Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year, consisting of the latter part of one year and the first part of the next

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Oct. 1st.	Closing Quotation Oct. 8th.	Business done week ended Oct. 8th, 1902. Highest.	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	† 10	...	5½%	...	3½ — 4½	3½ — 4½	...	...
£ 00,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 88	83 — 88	...	...
100,000	British Electric Traction	10	8 %	9 %	9 %	12½ — 13½	12¼ — 13¼	13¼	13
100,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12 5/16	12 3/16
£00,000‡	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127 xd	124 —127 xd	125½	125½
100,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	8 — 8½	7½ — 7¾	8 1/16	..
100,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¾ — 6¼	5½ — 6	6	5 11/16
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	...	...	...	102 —105	102 —105	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	3 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	16/0 to 16/6	16/0 to 16/6	...	...
105,731	Brush Elect. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	¾ — 1½	1 — 1½	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1 — 1½	1½ — 1¾	...	...
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	100 —103	100 —103	...	...
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	94 — 99	93 — 98	...	...
35,000	Callender's Cable Construction shares	5	15 %	15 %	20 %	15½ — 16½	15½ — 16½	16½	15 9/16
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¾ — 6¼	5¾ — 6¼	6 1/16	...
90,000‡	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,860,014	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	104 —107	106½	105
494,093	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	106 —109	107 —110	...	...
494,993	Do. do. Def. do.	Stock	...	...	4 %	103 —106	104 —107	105½	...
1,350,000	City and South London Railway	Stock	1½%	1½%	2 %	71 — 73	72 — 74	72½	71½
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	8 %	7½%	2 — 2½	2½ — 3	...	...
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅜ — ⅝	⅜ — ⅝	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ — 2	1½ — 2½	...	...
£44,023‡	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	74 — 78	74 — 78	...	...
100,000‡	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	77 — 82 xd	77 — 82 xd	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½ — 2	1½ — 2	1⅝	...
31,390	Do. do 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
2 ,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	5 %	5 %	10 — 10½	10 — 10½	...	...
£00,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	100 —103	101	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅝	...
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5¾ — 5⅞	5¾ — 5⅞	...	...
48,050	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	...	...
800,000‡	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102 xd	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅛%	3⅛%	1¼%	4 1/16 — 4 3/16	† 4 1/16 — 4 3/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	9½ — 10½	† 9½ — 10½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	14½ —15½	† 14½ — 15½	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	38 — 41	‡38 — 41	...	...
150,000‡	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	...	...
£40,000‡	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	90 — 93	90 — 93	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅞—1⅛.
National Electric Free Wiring, ⅜—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 2nd, 1902).

MARKET QUOTATIONS, Wednesday, October 8th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	23/-	23/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£36 10	£36 10	..
a „ „	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10s.	£7	50s. dec.
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£37 10	£37 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
c Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	5d.	5d.	..
a „ Caustic (76/80 %)	per ton	£24	£24	..
a „ Bisulphate	per ton	£8	£8	..
a Shellac	per cwt.	100/-	100/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a Bichromate, cakes	per lb.	3½d.	3½d.	..

METALS, &c.		This week.	Last week.	Inc. or Dec.
b Aluminium Ingots, in ton lots	per ton	£145	£140	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	6¾d.	..
c „ Tube (brazed)	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn)	per lb.	7d.	7d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Condenser Tubes (brazed)	per lb.	8¾d.	8¾d.	..
„ „ (solid drawn)	per lb.	9d.	9d.	..
g Copper Bars (best selected)	per ton	£69	£69	..
g „ Sheet	per ton	£69	£69	..
g „ Rod	per ton	£69	£69	..
g „ (Electrolytic) Bars	per ton	£67	£67	..
g „ „ Sheets	per ton	£74	£74	..
g „ „ Rod	per ton	£67	£67	..
g „ „ H.C. Wire	per lb.	7½d.	7½d.	..
f Ebonite Rod	per lb.	o/-	o/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/1½ to 3/3	3/- to 3/2	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	53/6	53/7	1d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£10 15 to £11	£11 to £11 2 6	dec.
g „ „ Sheet	per ton	£18	£18	..
m Manganin Wire No. 36	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	5/8 to 7/8	5/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/5	From 1/2	..
o Platinum	per ozs.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	£58	£58	..
i „ „ in bars	per ton	From £15 to £40	From £15 to £40	..
g Tin, block	per ton	£116 to £117	£117 to £118	£1 dec.
g „ foil	per lb.	1/6	1/8	..
n „ wire, Nos. 1 to 18	per lb.	1/6½	1/6½	..
p White Anti-friction Metals— "White Ant" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/18s Grey Cotton, on c'p's	per lb.	7d.	7d.	..
j „ 6 ins. Flax	per lb.	5¾d.	5¾d.	..
j „ 3 ply 18 lbs. Russian	per lb.	5½d.	6½d.	..
j „ 10 lbs. Russian, single	per lb.	4½d.	4½d.	..
j „ 180 lbs. Jute rove	per ton	£11 11	£11 15	..
b Zinc, Sheet (Vieille Montagne brd.)	per ton	£23	£23	..

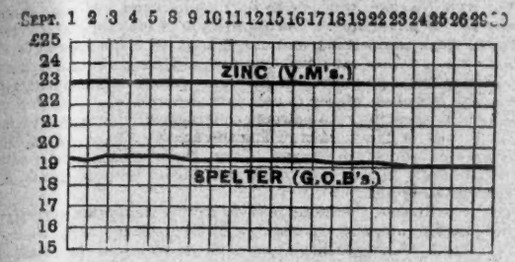
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works [Co., Ltd. g Messrs. James & Shakspeare. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

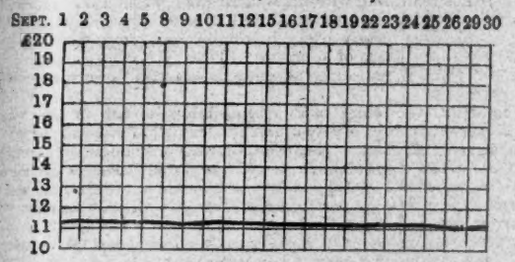
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

METAL MARKET.

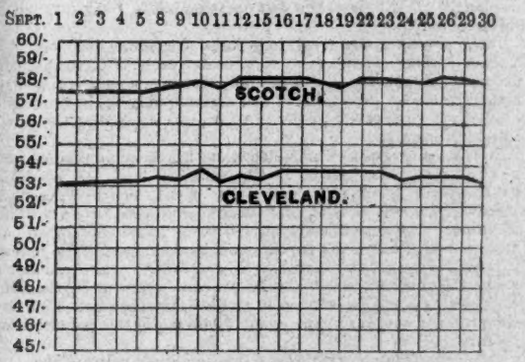
Fluctuations in September.



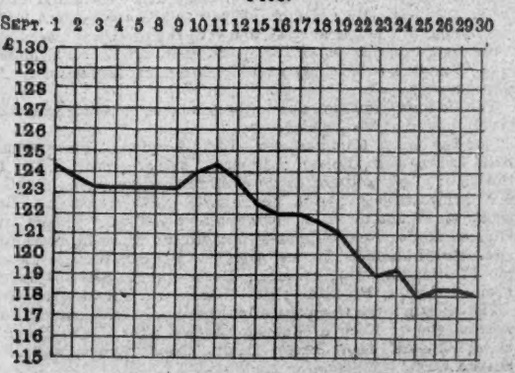
LEAD (ENGLISH).



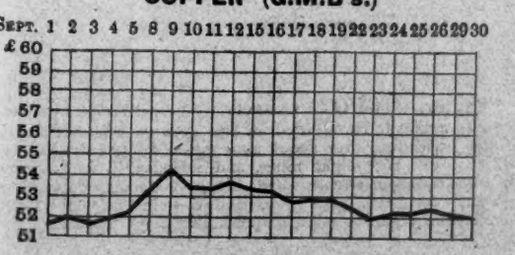
IRON.



TIN.



COPPER (G.M.B's.)



THE APPLICATION OF ELECTRIC POWER IN THE IRON AND STEEL INDUSTRIES.*

By D. SELBY-BIGGE (Newcastle-on-Tyne).

(*Concluded from page 598.*)

Air Compressor, Belt driving from Motor.

Operation.	Revs.	Volts.	Amps.	Electrical H.P.	Remarks.
Motor, shafting, and pumps	175	230	22	6·7	Air compressor, 9 in. diameter, 10 in. stroke
Pumping up to maximum pressure	170	230	70	21·5	Maximum pressure, 80 lbs.

Pattern Shop Motor. 15-Horse-Power Motor. 220 Volts.

Operation.	Revs.	Amps.	Volts.	Electrical H.P. Total.	Electrical H.P. Actual per operation.
Motor and shafting ...	170	9·5	233	2·9	2·9
Circular saw, 2 ft. 8 in. diameter, running light...	800	10·5	233	3·2	·3
Cutting yellow pine 11 in. deep, 7 ft. per minute — Max.	40	23	233	12·4	9·2
Cutting yellow pine 11 in. deep, 7 ft. per minute — Min.	18	23	233	5·6	2·4
Cutting yellow pine 11 in. deep, 7 ft. per minute — Average	29	23	233		5·8
Thickness machine, 2 ft. 6 in. bed, running light ...	3,800	12	230	3·7	0·8
Surfacing yellow pine 11 in. wide, 13 ft. per minute...	—	17·9	232	5·5	1·8

37-Horse-Power Motor.

Operation.	Revs.	Amps.	Volts.	Electrical H.P. Total.	Electrical H.P. Actual per operation.
Motor and shafting ...	—	12	230	3·7	3·7
Circular saw, 3 ft. diameter, running light	1,200	21	230	6·4	2·7
Sawing yellow pine 11 in. deep, 20 ft. per minute	—	71	230	21·5	15·1
Circular saw, 33 in. diameter, running light	—	26	230	8·0	4·3
Cross-cut lignum-vitæ, 9¼ in. deep × 18 in. long ...	—	41	230	12·6	4·6

30-Ton Cranes. Boiler Shop, 25 H.P. Motor. 220 Volts.

Operation.	Amps.	Volts.	Electrical H.P. Total.	Electrical H.P. Actual per operation.	Time.	Feet
Motor and shafting and belts (light)...	12	230	4·3	4·3	—	—
Heaving (light) ...	16	230	4·9	0·6	—	—
Cross travel (light)	15	230	4·8	0·5	—	—
Longitudinal travel (light)	16	230	4·9	0·6	—	—
Longitudinal and cross travel (light)	18	230	5·5	1·2	—	—
Travelling long. ...	16·2	230	4·9	0·68	1 min.	90 ft.
Weight 16 tons. heaving	36	230	11·1	6·2	1 min.	5 ft.
Cross travel... ...	30	230	9·2	4·4	—	—
Longitudinal travel	18	230	5·5	0·6	1 min.	90 ft.

Utilisation of Waste Blast-Furnace Gases.—This paper would not be complete without some reference to the great development which has taken place recently in utilising the waste gases from blast-furnaces for operating gas engines, which in their turn can be employed for directly driving blowing engines or dynamos, which latter in their turn would distribute electricity for power purposes throughout the works.

From the results of very carefully made experiments, conducted by Prof. Wits in July, 1898, and Prof. Hubert, in April, 1900, it has been found that a Cockerill "Simplex" engine of large size does not use more than about 100 cub. ft. of average blast furnace gas per effective horse-power per hour, which is less than one-fourth the consumption of gas required to develop the same power from boilers and good modern condensing steam engines, so that there is an immense surplus of power to be obtained from a blast furnace if the blowing engines are worked by gas, which can be still further increased if the gas is properly cleaned for the stoves, and its efficiency thus increased. It is estimated that for every 100 tons of

* Paper read before the Iron and Steel Institute at Düsseldorf, September, 1902.

coke used in an ordinary Cleveland blast furnace, after making ample allowance for gas for the stoves, and power for the lifts, pumps, &c., and for gas for working the necessary blowing engines, there is a surplus of at least 1,500 H.P., so that by economising gas by cleaning, and developing the necessary power by gas engines, every blast-furnace owner would have a very large surplus of power for his steel or other works, in the form of electricity or otherwise.

It would be impossible to overrate this new development in power production. In Great Britain really large sources of water power are practically unknown, and the sources from which electricity can be produced most economically will be undoubtedly due to the development of large power gas engines making use of the surplus gases from the blast-furnaces, which would otherwise be wasted.

Engines have been constructed and are at work, of 1,200 H.P., and an engine of this type is now building for no less than 2,500 H.P.

The Development of Electric Power Companies.—During the past two years great activity has been displayed in England in the formation of large electric companies, dealing with extensive tracts of country and covering under their Parliamentary powers vast areas for the supply of electricity in bulk to tramway companies, electric light companies, works owners, and for manufacturing purposes generally.

In certain cases, and under favourable conditions with regard to the district to be supplied, these companies may meet with success, but in many cases the author is of opinion the matter has been rushed into somewhat precipitately. Taking, for instance, a district of a fairly concentrated character, or in which a large number of small works and factories exist, absorbing each, say, 100 to 200 H.P., it might be found that with the power company supplying them with electricity at 1d. per unit, it would be more profitable and convenient to them to obtain their power from the company in preference to laying down their own plant. In cases such as this, the power companies should have a good field before them. When, however, the power company enters the field in districts where all the works are of an extensive character, and absorb 500 to 5,000 H.P. in electric current each, the case changes its aspect, and it will be found that it will be more profitable for the works owners to produce their own power.

On examining closely the cost of production of electricity by works owners in their own works, it is quite clear that with generating stations of 400 H.P. and upwards, equipped with economical and modern appliances in the shape of high-pressure boilers, mechanical stokers, triple-expansion condensing engines, working with superheated steam, &c., the cost of production should not exceed ½d. per Board of Trade unit, inclusive of interest and depreciation on the capital outlay. With blast-furnace waste gases this figure would be still less.

The author is of opinion that in the case of power stations in works dealing with 1,000 H.P. and upwards, and laid down upon the most modern lines, this cost of production can be reduced to 0·4d. per Board of Trade unit, as shown in the case of Messrs. Dorman, Long & Co.'s works.

Some of the cases have been taken from plants which have been in operation for some considerable time, and in which the very latest appliances and highest pressures may not be available. It would be most interesting with regard to the above subject to have the experience of those who have had the practical experience of producing their electric power, making use of large gas engines working with the waste gases from the blast furnaces, and to hear from them at what cost per unit they find they are producing their electric power, delivered at the switchboard.

Far be it from the author to discourage enterprise in any shape or form, especially as regards the formation of power companies, but that enterprise should be duly tempered with caution in formulating such large schemes.

It would be interesting to have the experience of our German friends on this point, as the majority of the large works have their own sources of power supply, and to hear from them the lowest rate at which they are producing their unit of electricity.

Conclusion and Summary.—The cases enumerated above demonstrate in a practical manner the advantages which have actually accrued from the substitution of electricity for steam or other forms of driving.

Electricity used as a motive power was, in the days when the author first treated the subject in the form of a paper, comparatively a new departure for the works manager and engineer. The enormous developments and strides which have been made during the past ten years in this branch of engineering render it necessary that every works owner and engineer should acquire a thorough knowledge of this subject.

We have in Great Britain been somewhat slow in making use of all the advantages which electricity has enabled us to reap. In many parts are to be found the same old low-pressure boilers which have done service for the past 30 years, with working pressures as low as 15 lbs. per sq. in. In other works are still to be found the same old beam engines constructed in the days of Watt and Stephenson. Works are still to be found in which over 100 small high-pressure and non-condensing engines are distributed with their mileage of steam pipes throughout the works—little or no attempt having been made to improve this state of affairs. It is in cases such as these that the author trusts this paper may be of service by showing clearly and in a practical manner the actual result which would accrue from the remodelling of the driving arrangements upon the electrical method.

In no country have we finer examples before us of the achievements of electricity as a motive power than in Germany, and we must all admire the skill, ingenuity, and above all, the enterprise of our German friends in this direction.

There are many outlying advantages which would accrue were works and industrial establishments driven electrically. There would be an enormous reduction in the smoke produced in large manufacturing centres, and a proportionately healthier state of things for the inhabitants.

In these days, when the idea of coalfields giving out is mooted, there would be a perceptible difference in the quantity of our coal consumption, which, although perhaps unpalatable to the coal-owner, would be most welcome to the manufacturer, who aims at the lowest cost of production. The application of electric power to the iron and steel, engineering, and manufacturing industries in Great Britain has certainly not developed with anything like the rapidity with which it has progressed in America and on the Continent, and the author has often wished to ascertain the reasons.

Generally speaking, the powers and responsibility vested in the general manager of a works in England are very different from what they are in a works in America. There the position is one of much greater latitude in the scope of innovations and improvements, and of responsibility also.

The actual result, therefore, is that improvements and savings are rapidly carried out, and the board of directors look to their manager for the expected improvement and savings, owing to the manager's minute knowledge of the details of the scheme he is putting forward and his great sense of responsibility in the matter. In the author's experience in dealing with firms in England, he has most frequently been struck with the small scope of initiative action allotted to the works manager, nearly every innovation and improvement being referred to the board of directors. This, in a very large degree, appears to be a retarding influence on electric power progress in our country.

In brief, the scope and responsibility vested in the works manager in America is very different from that allotted to the works manager in England. The board of directors' decision is responsible for the results obtained, and the works manager carries out the wishes of the board; on the other side the works manager is directly responsible to the board for the innovations that have been carried out.

There is one point that has most forcibly struck the author in dealing with improvement schemes for works.

Outside of our own country he has invariably been met with a first question, "What is the saving to be effected under the proposed scheme?" In England the first question put is, "What is the cost going to be?"

Both are naturally very important considerations, but many a time really great and immediate savings have been left unconsidered because of a mere glance at the first cost, and the documents have been pigeon-holed and shelved, only to be brought out when absolute necessity, not real enterprise, compelled them to be resorted to again.

In the many uses to which electricity has been applied as motive power, none has proved more suitable than its application to shipyards, dockyards, and other works of this description, possessing a great number of scattered and intermittently working machines. Our great dockyards both at home and abroad offer a case in which enormous savings could be effected. The reduction in working costs of a number of shipyards with which the author is acquainted has varied between 30 per cent. and 60 per cent. If this same saving could be effected in similar establishments, such as our Government dockyards, the result would be highly beneficial to the country.

In placing this paper before the Iron and Steel Institute, the author's one endeavour has been to show what are the immense possibilities and advantages to be derived from carefully considered electric power schemes. He has done his best to put the subject forward plainly and in a practical light, and if in the preceding pages he has given data, information, and subjects for thought and consideration to the members of this important Institute, his task will have been amply repaid.

The author's thanks are due to the following firms for information kindly placed at his disposal:—

The Lahmeyer Electrical Co., Ltd., London; Messrs. Siemens Bros. & Co., Ltd., London; Messrs. Laurence, Scott & Co., Ltd., Norwich; Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool and Middlesbrough; Col. Crompton, London; Messrs. Ernest Scott & Mountain, Ltd., Newcastle-upon-Tyne; Messrs. J. H. Holmes & Co., Newcastle-on-Tyne; Messrs. Dorman, Long & Co., Ltd., Middlesbrough; Messrs. Archibald Smith & Stevens, London; the Westinghouse Co., London; Mr. Alexander Siemens, London; Prof. Salomons, Frankfurt; the Allgemeine Electricitäts Gesellschaft, Berlin; the Compagnie Internationale d'Electricité, Liège; Messrs. Guest, Keen & Nettlefolds, Ltd.; Sir James Laing and Sons; Messrs. Short Bros.; Messrs. Craig Taylor; and Messrs. Scott & Co.

Exeter.—The City Council on September 25th decided on nine routes to be followed by the proposed Corporation electric trams, extending over about nine miles of single track in a street mileage of about eight miles, and including a section running through the main streets, which had been strongly opposed by the traders. The Committee estimated the cost of street works, including overhead equipment, at £6,500 per mile.

BRITISH ASSOCIATION, BELFAST, 1902.

THE SOLIGNAC BOILER.

By W. H. Booth, M.Am.Soc.C.E.

(Abstract of Paper read in Section G.)

Some time ago the Solignac boiler was brought to my notice, and impressed me with its novel and ingenious construction. A small boiler was lately put in my hands to test, and some very instructive figures have been obtained.

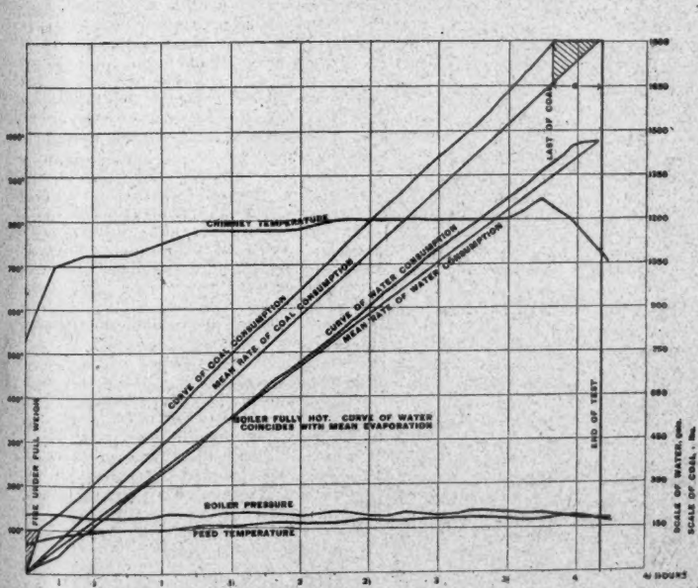
The boiler had a small steam drum maintained about half full of water. The lower part of the drum communicates with a flat header, whence issue 113 small tubes about 1 in. internal diameter (25 mm.). These extend to a length of about 4 ft., and are bent back on themselves in the form of a round-pointed V, and brought to a second header attached to the upper part of the steam drum. The tubes, therefore, discharge above the water level in the drum. The lower end of each tube is closed by a brass nozzle with an opening of about $\frac{1}{4}$ in., and the openings from the steam drum to the three divisions of the lower header are of small area. As during the tests each tube dealt with about half a pound of water per minute, it is obvious that the flow through the nozzles must have been very rapid. Half a pound would measure about 14 cubic in., and 0·23 cubic in. per second, which the rate of flow represents, would demand a velocity of 6 in. per second through a hole of $\frac{7}{16}$ in., which was the actual size of the nozzles of the 113 tubes. The flow in the lowest row of tubes would be greater than the average.

The principle aimed at is to secure a supply of water, not seriously greater than the tube will evaporate, so that very little water is discharged with the steam, and the head producing circulation approximates to the height of the water level above the tubes.

In the Solignac boiler tested the ratio of heating surface to grate surface is only 37 to 1. Yet this small surface gave an efficiency of heat absorption of over 60 per cent., with a rate of coal consumption of 43 lbs. per square foot of grate-surface, a rate that was obtained with a draught of only 1 in. of water gauge at the base of the chimney.

A volume of 0·23 cubic in. of water when converted to steam at an absolute pressure of 150 lbs. per sq. in. has a volume of 43·1 cubic in., hence the mean velocity of flow of steam in the tubes is fully 4·6 ft. per second.

With hot feed this boiler, with 10 sq. ft. of grate surface, will deal with at least 4,000 lbs. per hour of water, and will produce that amount of dry steam. Probably some of the tubes deliver superheated steam to the drum. A suitable diaphragm separates the steam outlet from the discharge of the tubes, and the driest steam comes in above the moister steam, and assists to dry the whole. No trace of moisture is to be found when discharging 4,000 lbs. of steam per hour to the atmosphere.



Tests of the Solignac Boiler.

In the small boiler referred to, the whole floor space occupied is only 27 sq. ft. If supplying steam to a good compound engine on a steady load, the boiler would thus produce steam for 250 I.H.P. from hot feed at 212° F., and should produce more with a higher draught than 1 in. It might therefore be called on to supply steam for 10 I.H.P. for each square foot of floor space occupied, or about 1 I.H.P. for each cubic foot of total volume contained within the casing.

Such an output is exceedingly high, and points to the value of the boiler as a steam generator for small vessels of the torpedo boat type. Steam can be raised from cold water in a few minutes, the water contents of the boiler being small. This rapidity of steam raising points out the boiler as an extremely useful adjunct to an electric light or power station. By the aid of a couple of shovels of fire from a working boiler, the use of a steam jet or fan draught, and a few gallons of hot water from another boiler, or from the ordinary hot feed, this little boiler, in 5 minutes, could be pouring out steam at the rate of 3,000 or 4,000 lbs. per hour with regularity. These characteristics, then, render the boiler particularly well suited to deal with the sudden accession of load demanded by a fog in a lighting station. They also show its fitness for dealing with the brief peak of the ordinary night load.

Most water-tube boilers have a heating surface 50 to 70 times their grate surface, the latter number being the ratio of a Thorneycroft boiler. With a coal consumption of 66·8 lbs. per foot of grate, the Thorneycroft* boiler evaporated 8·5 lbs. per foot of heating surface with an efficiency of 66·6 %, and a performance factor of 87·4, the heating surface ratio being 1·878 greater than that of the Solignac boiler, and the coal consumption per foot of heating surface, therefore, being $\frac{1,530}{1,878}$, or 0·8146 that of the Solignac.

At 29·8 lbs. of coal consumption per square foot of grate per hour, the Thorneycroft boiler had an efficiency of 78·2 per cent., an evaporation of 4·7 lbs. per foot of heating surface, and a performance factor of only about 56. These figures are very striking testimony for the Solignac boiler which is unrivalled as a generator of steam per unit of floor area or volume occupied.

Priming in steam boilers is due to ebullition of the mass of water in the boiler, steam rising through the water surface and carrying upwards with it films of water. In the Solignac boiler, as in all which deliver their circulation water above the water level in the drum, there is no priming, the water which circulates with the steam being thrown down upon the surface of the water in the steam drum, parting with its steam above that level. The water in the drum remains quiescent, and only enters into ebullition should the steam pressure fall quickly, when, of course, the surplus heat in the water is given up to the steam which escapes owing to the reduced pressure. The inventor of this boiler, who, unfortunately, died during the time I was engaged in testing it, held that a tube which evaporated 10 kilos of water per unit of length was less cooled by the water than one which evaporated 20 kilos. In the one case he held that the surface of the tube was cooled by the absorption of heat by the water, and in the other case it was cooled by the giving up of heat to water that was in rapid motion, and ready to absorb heat in becoming steam. He then constructed his boiler with three principles in view.

1. The presence of the diaphragms with small perforations to avoid choking the tubes with water.

2. The cleaning by reverse flow of steam, which is effected by closing the water supply cocks on the down-comer to the lower header, and opening the lower blow-out cocks which permit steam to flow back through the tubes to the blow out.

3. The whole bundle of tubes, and the steam drum, are so constructed and carried that they can be turned out of the casing for examination in a few minutes, and replaced as readily. This is effected by carrying the drum on two hinged columns. By removing the securing cotters, the whole boiler can be let out of its casing, every tube examined, and the interior lining of the casing examined and replaced, or repaired, with ease in every part. For convenience of repair, blow out, &c., the tubes are set in several headers, three in the case of the boiler tested by the author.

The salient features of two of the tests are given on the next page. The first five tests were made with a grate having narrow air spaces between the bars, and the bar surface was divided into $\frac{3}{4}$ squares by transverse air slots. The other two tests were made with a plain straight English bar with $\frac{1}{4}$ air spaces. While easier to clean, it did not so well distribute the air, the fire burned sooner into holes and the efficiency was less. A notable feature is the evaporation per square foot of floor space. This is one of the most valuable features of the boiler looked on as an emergency boiler or for use in torpedo boats, because it enables so large a steam producing capacity to be placed in a limited space.

During the progress of the tests, both coal and water were supplied in small weighed quantities, in order that the curves of consumption might be drawn with fair accuracy, and these show how exceedingly regular was the performance by the boiler.

The whole of the seven tests were run with the best Welsh coal, Nixons, or Powell Duffryn. The amount of smoke was slight, there being a fair height above the grate before the gases entered the tubes.

The maximum heat transmission of the Thorneycroft boiler per minute per square foot of heating surface was 153 B.Th U. This figure is much below several tests of the Solignac boiler except that with $\frac{1}{4}$ in. natural draught only.

In addition to the tests made by myself, the boiler has also been tested by the Vulcan Insurance Company, with very similar results.

The rate of coal consumption per square foot of grate per hour during the boiler company's test was 39·6 lbs., and the evaporation per pound of combustible from and at 212° was 9·61 lbs. The efficiency of the boiler was 62·0 per cent.

Other tests were made by the insurance company at different draughts and with different thickness of fire, and they are all con-

* See *Trans.* I.C.E., Vol. xcix.

sistent with the figures obtained by myself; indeed, one of the most striking peculiarities of the boiler is the extreme regularity in its performances and the ease with which accurate results can be obtained when testing it.

The calorific capacity of all the coals throughout the tests is practically 15,000 B.T.U.

	June 21st, 1902.	June 21st, 1902.
Draught. Water gauge ... ... inches.	½	1
Boiler pressure ... ... lbs.	133	127
Feed temperature ... ... degrees F.	64°	64°
Coal, per hour	196·9	425
Grate surface ... ... sq. ft.	10	10
Coal, per sq. ft. of grate surface per hour lbs.	19·69	42·5
Water per lb. of combustible from and at 212° ... ... lbs.	10·758	10 84
Heating surface ... ... sq. ft.	372	372
Water per sq. ft. of heating surface from and at 212° per hour ... ... lbs.	5·38	11·92
Grate bars	French	French
Evaporation per sq. ft. of floor space per hour from and at 212° ... ... lbs.	74	164
Mean rate of heat transmission per sq. ft. of heating surface per minute ... B.Th U.	86	192
Performance factor	57·8	123
Water evaporated per hour ... lbs.	2,000	4,435

THE ELECTRICAL CONDUCTIVITY OF CERTAIN ALUMINIUM ALLOYS AS AFFECTED BY EXPOSURE TO LONDON ATMOSPHERE.

By Ernest Wilson.

(Paper read in Section G.)

The physical properties of certain light aluminium alloys have formed the subject of a communication,* and, as stated therein, a specimen of each alloy was placed on the roof of King's College, London, in order to investigate the effect of exposure to London atmosphere. The specimens are in the form of wire, 0·126 in. (3·2 mm.) diameter, supported on a wooden frame, and were placed on the roof on June 11th, 1901. They have been tested after about 13 months' exposure, and have revealed some interesting facts. In order that the chemical analysis may be inspected it is again given in the following table, which gives the results of the tests. It is assumed that the observed effects are principally due to pitting at the surface, but exposure might also affect the structure of these alloys:—

No. of specimen.	Analysis.						Specific resist. in 10^{-6} legal ohms before exposure on June 11, 1901.	Percentage variation of specific resist. as found on July 23, 1902.
	Si.	Fe.	Cu.	Ni.	Mn.	Zn.		
16	0·31	0·37	0·11	—	—	—	2·92	1·81
4	0·38	0·25	0·16	—	—	—	2·88	1·83
13	0·38	0·25	1·58	—	—	—	3·34	4·50
14	0·40	0·31	1·86	—	—	—	3·25	6 18
15	0·40	0·40	2·61	—	—	—	3·34	8·07
1	0·38	0·22	0·17	—	—	0·62	2·86	1 98
2	0·43	0·28	0·30	—	—	1·20	2·94	1·30
5	0·43	0·39	0·09	—	—	2·04	3·07	2·30
7	0·37	0·25	0·05	0·75	—	—	3·05	1·21
8	0 35	0·29	0·09	1·19	—	—	3·24	2·07
20	0·37	1·10	0·06	2·25	—	—	3·18	1·64
24	0·35	1·16	0·09	—	—	—	2·97	0·60
3	0·37	0·28	0·59	—	—	0·59	3·06	2·49
6	0·39	0·31	0·63	—	—	1·20	3·12	2·00
17	0·35	0·53	0·10	0·83	—	0·90	3·03	0 99
12	0·31	0·59	0·19	1·09	—	0·73	3·33	1·21
18	0·43	0·40	0·21	1·13	—	1 94	3·24	2·59
19	0·35	0·29	0·11	2·01	—	1·77	3 26	3·21
11	0·39	0·56	0·24	2·31	—	0·38	3·48	1·93
22	0 37	0·43	1·08	1·29	—	—	3·41	−1·41
21	0·39	2·57	0·10	1·39	—	—	3·24	−0·80
10	0·32	0·54	0·02	—	0·05	—	3·09	0·62
9	0·31	0·35	0·03	—	0·35	—	3·30	1·92
23	0·44	0·56	0 09	—	1·78	—	3·49	2·20

The position of aluminium in the electro-chemical series with respect to the other substances in the analysis is as follows:—Al, Mn, Zn, Fe, Ni, Cu, Si. We should expect to find that copper, widely separated as it is, would be effective in the production of corrosion. This is found to be the case (specimens 16, 4, 13, 14, 15), the effect increasing with the percentage of copper. Nickel is well separated from aluminium in the series, and alone (specimen 19) has considerable effect, but if alloyed with copper (specimen 22) the conductivity has slightly increased during exposure. This specimen is specially promising, as it has a breaking load of 45,900 lbs., and limit of elasticity of 36,600 lbs. per square inch. It has, comparatively, a low percentage extension (0·146 with 16,250 lbs. per square inch), a high coefficient of expansion (0·0000252), and a low temperature coefficient for electrical resistance (0·00178 per 1° C. between 0° C. and 100° C.). Again, iron in the presence of nickel (specimen 21) has slightly increased conductivity. This specimen has a comparatively high-breaking load of 42,200 lbs. per square inch, and its conductivity is slightly larger than in specimen 22. Silicon is the most widely separated of all the substances in the above series, and it should be remembered that all commercial aluminium contains traces of silicon and iron. Since these alloys were supplied the purity of commercial aluminium has been greatly improved, so that further research may yield results from which more definite deductions may be made. For exposed light aluminium alloys it appears that copper alone should not be used in the alloy; the presence of equal amounts (about 1 per cent.) of nickel and copper certainly reduces conductivity to a small extent, but the gain in mechanical and corrosive properties is great.

* See *Journal* Institution of Electrical Engineers, 1902, Part 154, Vol. XXXI.; also British Association *Report*, 1901; also *Journal* of the Society of Arts, December 13th, 1901.

THE EXPERIENCES OF A TELEGRAPH ENGINEER IN PERAK STATE, 1898—1901.

By D. P. REID.

(Concluded from page 581.)

The elephant in Perak is also a cause of trouble at times, especially the rogue species. These otherwise useful beasts come out at night on mischief bent, and amuse themselves by pulling up the telegraph posts and sleepers from the railway.

On one occasion there was great excitement in the neighbourhood of a small station named Chikus, in Lower Perak.

A goods train left Teluk Anson at 6.40 a.m. one morning, and on its arrival within a quarter of a mile of Chikus an elephant appeared on the scene; he was walking leisurely forward along the line and did not see the approaching train, so that the driver was compelled to slow down and blow his whistle with a view to frightening the huge beast away.

The elephant, however, who was of a different opinion, turned round and disputed the right of way; the driver thereupon reversed and backed the train, and then going forward again, collided with the beast with such force as to crush in his head and splinter the tusks.

The beast was thrown down the embankment, and although not quite dead, was disabled, and finally despatched by a bullet from a Snider rifle carried by a Sikh who was travelling in the carriage usually attached to these trains.

Sometimes in the early morning certain stations are unable to work the telegraphs successfully owing to the bad insulation of the lines. Grass and shrubs grows so long and quickly that it is difficult to keep the lines entirely clear, and therefore until about nine or ten in the mornings telegraph working is often only possible with increased battery power on account of the heavy dew. When the sun, however, has exerted its drying power over the country, working is much improved.

In this hot and damp country it is hardly possible to obtain any good results from taking morning tests; the great object in view is to keep the telegraphs working, and the telegraph engineer should feel satisfied if he can do this.

Lightning flashes nightly in the Straits (and perhaps daily could we only see it), and the displays are really beautiful indeed; it is astonishing what little damage is done, considering the severity and frequency of thunderstorms in Perak. In many cases it is sheet lightning, but sometimes we were favoured by something worse. In the Batang Padang district a tremendous flash of lightning split to pieces five telegraph posts at a time and threw the line to the ground unbroken. The natives, who are very superstitious, were terrified, and it was with great difficulty that they were persuaded to return to work in that locality.

On another section of railway, in Krian, new telegraph lines had been fitted up, and G.P. leads run into a station called Sungei Bogak. In order to keep the continuity of the line good, the G.P. of the "up" line and that of the "down" line were joined "through" inside the station office and left for a while pending the arrival of the apparatus. All went well for a while, when one morning the Tamil station-master came to his station at 6.30 a.m., and finding the telegraph office wall broken outwards (a wooden station), he sent a message to the district inspector, who, suspecting burglary, called the police to the scene.

On their arrival and entrance to the office, they found that nothing had been stolen, and were much puzzled as to how the station boarding had been broken.

As I was in the locality, I took a run down, and found that a discharge of lightning, having caught the "up" line, came into

the office, and discharged itself to earth, and so great was the expansion of air due to the heat generated, that one side of the office was blown out.

In one section of line when the rails were being laid, a telegraph line had been in course of erection, unknown to me, for a few weeks, and moreover, had been placed in the hands of an ignorant Tamil contractor.

On being informed of this, I at once proceeded to the locality and found about 5 miles of telegraph posts had been put up, and the contractor, thinking he might raise himself in my estimation, mentioned that the posts had been erected in five days.

I looked at his staff, which was so small that the feat was an impossible one, and on examination the poles were found to have been planted only a little over a foot deep, and could just manage to keep up; when I gave some of them a slight push, over they went.

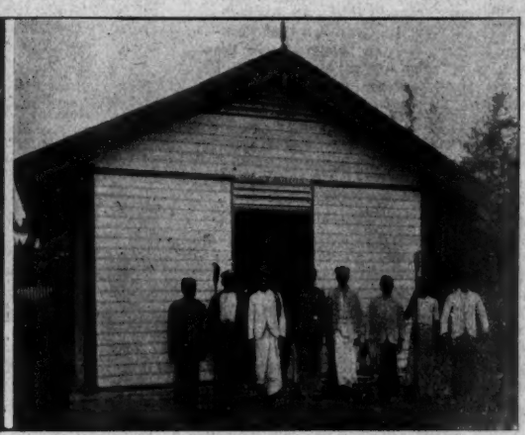
The only remedy now to rectify the bad work, was to set my men on to push the whole 5 miles of posts down, and make the contractor do the needful under supervision.

During my travels in Perak, I had the pleasure of meeting his Highness the Sultan several times, at the Residency and other places, and was allowed to take his photograph.

In conclusion, let me say that I cannot imagine a more lovely country than the State of Perak, and although I left on account of health, I have now a longing to be back in this sunny land of native life, with its weird customs, &c.

Attached are few copies of coolie petitions. These are generally written by paid petition-writers, whose idea of the English language can be better imagined than described.

My Bungalow in Perak.



Group of Telegraph Linemen.

Copies of Petitions from the Members of my Staff.

Most honoured Sir,—With due respect and profound submission, we beg to bring the following few lines to your favourable consideration, hoping to meet with success.

We suffering very difficult to our works. (1) We must go all the service thick jungle that were the tigers living, we saw our own eyes that the tiger going.

(2) We must go up the telegraph posts these were containing the terrible ants, and it gives us very pain.

(3) We must drink the bad water.

(4) We must stopped the said places one or two days. We suffering by this kind your honour also knows all these things.

We therefore humbly beg your honour will kindly mercy upon us and increase our pay, and thus protect us an our poor family. For which act of kindness and cherity we shall ever pray for your long life and prosperity.

We beg to remain most honoured Sir,
Your most obedent servants.

Sir,—I beg to inform you from this morning I am suffering from h[illegible]y-hack. Kindly grant me a letter to Hospital for treatment ex[illegible]se me for the troubles

I beg to remane, etc.

[copy of a telegram.]

"Please send lineman first opportunity to *execute* the telegraph instrument in my office urgent."

Honoured Sir,—I the undersigned most respectfully beg to bring t[illegible] following few lines to your honours kind and merciful con[illegible]ration hoping it will meet with success.

I have been working under your kind control about 15 months without any mistak.

Now I received a letter from my brother in Penang and he is very bad therefore I must go there urgently. But I cannot say when can I come back therefore I must go there to-morrow. I therefore humbly beg thy honour will kindly mercy upon me for which act of charity I shall ever pray for your long life and prosperity.

I beg to remain, etc.

DR. MUIRHEAD'S NEW MODE OF TRANSMISSION AND RELAY FOR CABLES.

By JOHN MUNRO.

(*Continued from page* 604.)

This effect of the self-inductance in straightening the zero is illustrated by fig. 7, where the dotted line of specimen A represents the shifting zero when the shunt is not applied, and the full line of specimen B, which is equal and opposite to A, shows the ground current passing through the shunt to earth, while specimen C gives the signals thus corrected by the shunt.

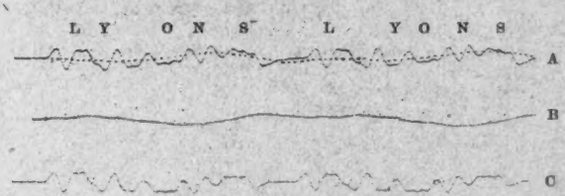


Fig. 7.

On adjusting the inductance and resistance of the shunt, along with the receiving condenser and its shunt, the signals are effectively curbed and shaped at the receiving end without reference to the sending station. The adjustment of the self-induction shunt will be understood from fig. 8, where specimen A is a deflection of

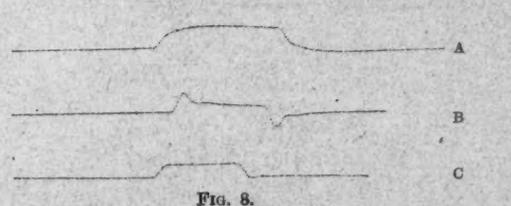


Fig. 8.

the siphon when there is too little self-inductance and too much resistance in the shunt, specimen B shows too much self-inductance and too little resistance, and specimen C the right amount of self-inductance and resistance to give the "square" signals.

It is plain that signals of this kind resemble the "dots" and "dashes" of the Morse instrument; a single "dot," for example, the letter "e" appearing as a short deflection or peak, and a triad like the letter "s" as a long deflection or tableland. The new form of signals is by no means a disadvantage in reading them. On the contrary, their sharp, regular, definite character, makes them easier to read than the old, uneven, slovenly signals, and experienced operators prefer them, whilst there is also a gain of speed in practice.

At the sending end the ordinary signalling key and short signals may be employed, but in order to get full advantage of the new method from the beginning, short and long signals corresponding to the deflections of the receiving coil can be sent, and for this purpose Dr. Muirhead has provided a special sending key.

This reformation in submarine telegraphy, which may become general, was first described in his patent No. 5,589 of 1901, and adapted to his relay. It renders the "overflow" circuit through the signal coil, as well as the splitting-up of signals in the local circuit practically needless, but should the split signals be desirable in any particular case, Dr. Muirhead has two or three ways of adding

them. A very simple plan, for example, is to insert in the local circuit a mechanism which applies a shunt to the receiving coil of the relay at intervals corresponding to the duration of a short signal, thus indenting the long square signals, and, so to speak, serrating the table-lands.

Various apparatus for working the new mode of transmission were illustrated by Dr. Muirhead in his patent, No. 10,120 of 1901, including a combined siphon recorder and relay. The vibrating jockey tongue relay, though a satisfactory solution of the problem, was abandoned for simpler and more sensitive arrangements. In his combined recorder and relay, fig. 9, a taut phosphor-bronze wire W, from the cradle of the siphon C, is vibrated by an electro-magnet M between the two terminal stops, S, S, of a weak local battery, and makes contact with them, as the coil swings, for a shorter or longer period, according to the duration of the signals, thus actuating two Post Office or such like relays, and sending signals from a stronger battery into the cable.

Another device of Dr. Muirhead for carrying out the Varley principle of moving contacts is a revolving wheel or cylinder of gold, silver, or some other decohering metal, with two springs, which apply directive force by taut filaments to the signal coil, resting against it, so that when the coil sways under the received signals, the springs break or make their contact with the cylinder, and in so doing open or close the local circuit.

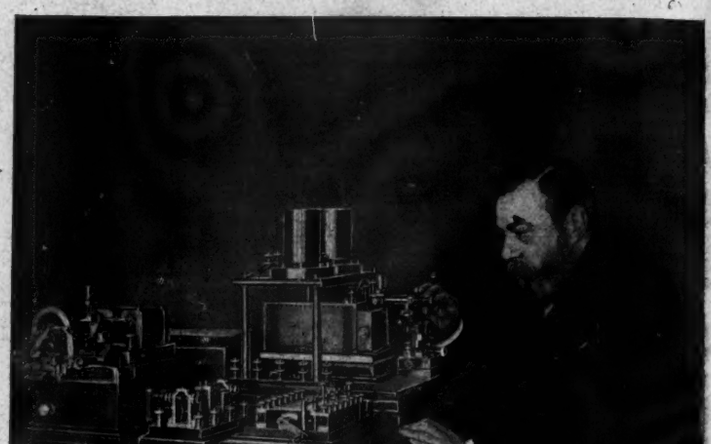


FIG. 11.

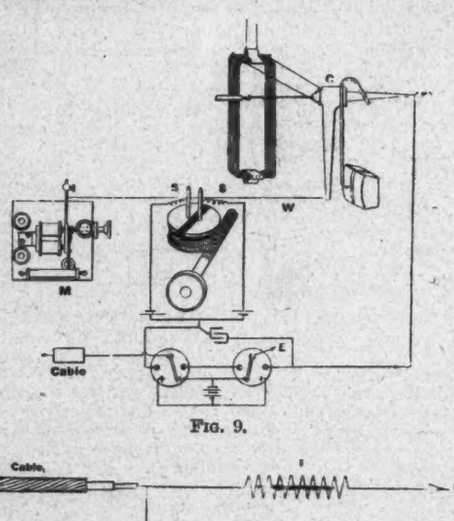


FIG. 9.

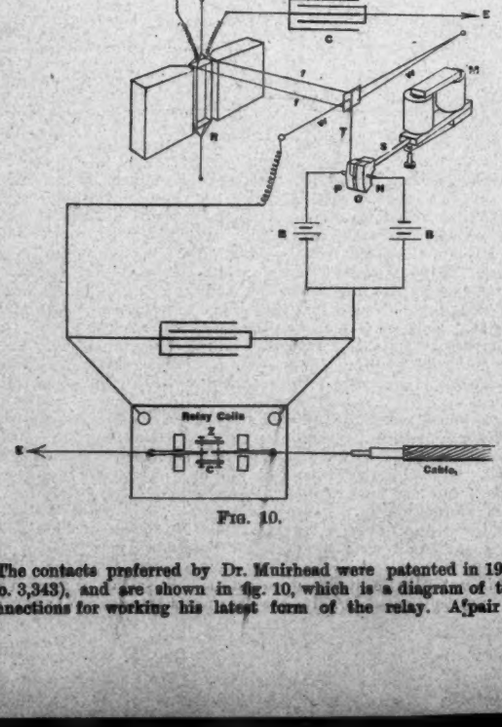


FIG. 10.

The contacts preferred by Dr. Muirhead were patented in 1900 (No. 3,343), and are shown in fig. 10, which is a diagram of the connections for working his latest form of the relay. A pair of small silver plates P P, a little convex, are mounted side by side on a flat spring S, and vibrated up and down by an electro-magnet M, like the clapper of an electric bell. The vibrating plates are the terminals of a local split battery B, B, and between them is a fixed partition orifence of silver P O, insulated from them by strips of mica. The tongue T, or "trailer," is of metal, with a recurving point, and hung, like the siphon of a recorder, from a "cradle," supported on taut wires *w w*, and attached by the filaments *f f* to the signal coil R of the receiver, which is connected to the end of cable 1, and through the self-inductance I as well as the condenser C, to earth. The cradle, and with it the tongue, is joined to the middle of the split battery through an auxiliary pair of sending relays, which in this case are sounders, but may be of the Post Office or another pattern. The stops of the sounders are connected to the poles, *c*, *z*, of a local sending battery, and their contact levers, one to cable 2, and the other to earth.

The tongue or trailer, T, usually rests in the middle zone or zero position, O, which resembles a neutral ground or "buffer state" in politics, but when signal currents from the first cable pass through the coil R, it strays into the adjoining territories, P, N, making contact with one or other pole of the split battery, B, B, thus actuating the sending relays and repeating the signals into the second cable. The trailer works easily and well. Apparently the vibration of the plates not only diminishes the friction, but shakes off the dust and ensures a good light rubbing contact.

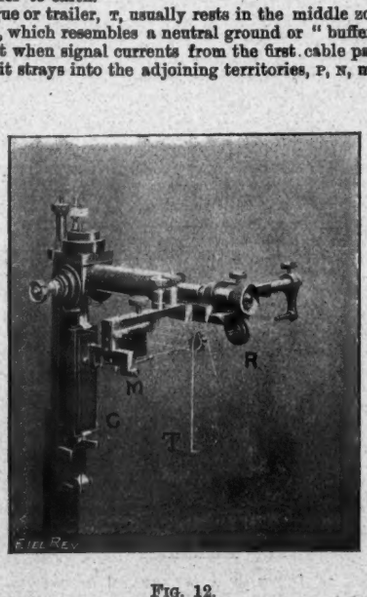


FIG. 12.

The photograph, fig. 11, shows the Muirhead vibrating relay as now made, having the switch, two sending relays or sounders, and also a local recorder on the same base.

Fig. 11 illustrates the suspension piece of the recorder and the relay with the signal coil, C, connected by two fibres to the cradle from which hangs the siphon or the trailer, T, as the case may be. A small electro-magnet, M, serves to vibrate the point of the siphon by means of a spring armature to which one side of the cradle is

attached by a single fibre. The other side of the cradle is suspended by two fibres (see fig. 10) which, like the strings of a violin, pass over a kind of "bow" inside the sliding ring, R, which is adjusted to regulate the tension of the fibres and period of vibration of the siphon or trailer.

Thanks to the correspondence of design, any siphon recorder can quickly be transformed into a relay, or *vice versâ*, by exchanging the siphon for a "trailer," and the frame carrying the paper and ink for that with the vibrating plates, or the contrary.

Ordinary earth currents do not disturb the signal coil of the relay, because the self-induction shunt to earth only permits a very small fraction of them to pass through the coil, but if they are exceptionally strong anywhere, a special device is added to the relay by which they excite a pair of small electro-magnets acting through a simple mechanism on a directing fibre attached to the cradle so as to maintain the zero of the trailer.

(*To be concluded.*)

ELECTRIC LIGHTING OF TRAINS IN GERMANY.

The Prussian State Railway authorities have at last begun to move in the direction of introducing the electric light in the carriages of passenger trains, thus following the example set by the German Imperial Postal Administration some time ago in regard to the electrical illumination of the night mail vans on some of the railways. At present about 1,500 mail vans are electrically lighted from batteries carried in the vans, and the cells are either recharged at one or other of the 30 stations provided for the purpose, or freshly charged batteries are already waiting to be substituted for those which have been discharged. As recently as January 18th, 1900, the Minister of Railways expressed an opinion adverse to the adoption of electric lighting in trains, and he even went so far as to repeat the statement of the technical attaché at the German Embassy in London, to the effect that the representatives of two English railway companies proposed to pay a visit to Germany in order to investigate the system of mixed gas lighting and compare it with their electric lighting methods. The Minister further remarked that the mixed system of gas illumination was superior, although he admitted that the electric lighting of mail vans afforded greater security, and that the latter form might be introduced in passenger coaches at some time or other. Since then, however, Germany has been startled by the terrible railway accident at Offenbach, where a number of fatalities occurred in consequence of the passenger coaches being set on fire through the smashing of the cylinders containing the gas provided for the illumination of the compartments. Whether this calamity—which recalls the similar event at Clapham Junction some years ago which was accompanied by less disastrous results—has produced any effect upon the German State railway authorities, is a matter for conjecture, although the Teutonic newspapers were almost unanimous at the time in their demands for safeguards against a repetition of the burning train misfortune in the future. At any rate, the authorities have recently made a commencement by equipping two of the so-called Swedish trains—D 17 and D 18—which travel between Berlin, Stralsund and Sassnitz.

In the experiments now in progress the State railway authorities have considered it inadvisable to adopt the system of providing a dynamo driven from the axle of each coach, together with a battery for each carriage, or that of installing an accumulator in each coach capable of being removed for re-charging purposes and a freshly-charged battery substituted. What they have done is to arrange a generating set on the locomotive and a battery in each passenger carriage in the hope that this method will, as far as practicable, succeed in reducing the initial expenditure and the cost of maintenance and attendance, and at the same time best meet the requirements of the railway service in the matter of simplicity and reliability. The motor used on each of the trains, which it should be mentioned are not broken up on the journey in either direction, is a de Laval steam turbine, the high speed of which is reduced by means of a countershaft to that suitable for the dynamo which supplies the batteries and lamps throughout the train. It is reported that other trains are being equipped on this system, which would involve a total expenditure of about £2,000,000 for its installation on all the passenger trains throughout Prussia.

As bearing on this question, it may be mentioned that in Switzerland the Jura-Simplon Railway and the Central Railway Co. have for some time past had in operation passenger trains lighted by electricity. Each car is fitted with a battery, which is capable of furnishing light for 35 hours, and an electricity hour-meter is provided for indicating to the attendant the number of hours during which current is still available. It frequently happens that fresh batteries are already on the platform awaiting the arrival of the trains at the charging stations, and they are quickly removed from the hand barrows by two men and substituted for the exhausted batteries. The lamps are switched on and off by the guards, and are also brought into use in the day time during the passage of tunnels. It is considered that this system, besides having other advantages, presents the important feature, in case of a railway accident, of at least allowing some of the coaches to remain alight, whereas an interruption of the generating source on the locomotive or luggage van would plunge the whole train in darkness.

It appears that the experiments of the Prussian State railway authorities are not to be restricted to turbo-dynamo sets on the locomotives, as a trial is now being made of what is termed the "Frankfort system," as devised by the Pollak Accumulator Co. of that town. The company has fitted a new coach, which is on the point of being turned out of the local railway workshops, with 32 lamps and two batteries which are energised by a dynamo belt-driven from the carriage axle. The system, which is said only to require occasional inspection, is also to be extended for use in the case of "unbroken" trains where a single dynamo would be employed for the supply of the whole train.

THE AMERICAN ELECTRO-CHEMICAL SOCIETY'S MEETING.*

The second general meeting of the Electro-chemical Society, held at Niagara Falls in September, was well attended.

The secretary reported that there are now 411 members in the Society.

Mr. Francis A. J. Fitzgerald, in his paper on "Notes on Testing Carbon Electrodes," stated that the efficiency of the electrode depends largely on its density, and the paper dealt with two methods for the determination of density. First, of the density of the carbon of which the electrode is made, and, second, the apparent density or the ratio of the weight to the volume of the electrode as a whole. The difference of these quantities divided by the first-mentioned expresses the porosity. The paper gave the method of determination in minute detail. In the case of a specimen the real density was found to be 2·19, the apparent density 1·63, and the porosity 0·26. In certain electrolytic processes the presence in an electrode of amorphous carbon is undesirable, owing to the accompanying disintegration, and the paper described a method of testing to determine if they are entirely composed of graphite.

In discussing the paper Prof. W. H. Hart suggested the use of persulphuric acid to separate the two forms of carbon. Mr. Fitzgerald stated that this had not yet been tried.

Mr. Alfred T. Weightman read a paper on "Cathodic Reduction," giving a detailed account of the investigation of the behaviour of lead in the process now being used at Niagara. The author of the paper said that much less hydrogen is released than the rule calls for, and this fact is of advantage in commercial working. The higher voltage accords with the views of Caspari and others, that the voltage necessary to liberate hydrogen is not a constant, as implied by Thomson's rule, but is dependent on the metal which constitutes the cathode.

Prof. Haber, of Germany, took part in the discussion of the paper, and claimed that Caspari's theory of over-voltage was correct and applied to the experiments in question. The Professor said there may be intermediate steps between ions and gases, such as solution, absorption, the formation of an alloy, &c.

Prof. Richards read his paper on the "Efficiency of Electric Furnace Operations." He discussed a number of operations—the first being electrolytic. "Here," he said, "the voltage is partially absorbed in overcoming the counter-electromotive force set up by the material being decomposed, and the efficiency is the ratio of this voltage to that actually used. Furnaces proper are of two kinds—continuous and intermittent. In the first the furnace is charged and brought up to the proper temperature, and then by continuous feeding in, the process is kept up. In this furnace the efficiency is the ratio heat used to heat developed in the furnace. The loss is that due to radiation. In the other type the furnace is charged and then brought up to the temperature of reaction when it is allowed to cool. The heat radiated from this time is useful and cannot be considered as loss. The loss is only the heat radiated while the furnace is being brought up to the proper temperature. The efficiency varies with size of furnace from 10 to 90 per cent., and is higher in those where no chemical reaction takes place. In commercial sizes these have an efficiency from 65 to 75 per cent. In the chemical furnace the efficiency in commercial sizes is from 50 to 60 per cent. The losses in all furnaces are due to radiation, and hence the better efficiency of large sizes as the radiating surface increases with the square of the dimensions only while the charge or volume increases as the cube. The efficiency of the continuous furnace can be raised by running the charge through rapidly." Figures for the calculated efficiency of various furnaces were given.

In reply to questions by Mr. Brinley as to the reduction of radiation loss by double walls, Prof. Richards said the important factor is whether the operation is conducted quickly or slowly. Mr. Hering suggested that a rating of pound output per kilowatt-hour was a convenient method of rating furnaces.

Prof. Louis Kahlenberg, in his paper on "Differences of Potential between Metallic Sodium and Solutions of Cadmium Iodide in Various Solutions," gave an interesting account of his study. He said the greatest potential difference was measured between cadmium and cadmium iodide in a large number of various solutions, in each case the other electrode being Helmholtz's normal electrode, and the general result was that the potential difference between a metal and a solution is primarily determined by the chemical affinity.

Prof. Hart read Mr. Marcus Ruthenberg's paper on "Developments in Electrometallurgy of Iron and Steel." The author's method as outlined consists in principle "in using an electric

* New York *Electricity*.

furnace combined with the action of a magnetic field. The melting zone of the electric furnace is a magnetic field. The ore being magnetic, the magnetic field seizes and holds the grains of the magnetite, and the polar projections being at the same time the electrodes of the smelting circuit, the magnetic bridge thus formed by the ore becomes a high resistance in the smelting circuit. The heat of the smelting circuit is engendered within the bridge of ore itself. The electrodes are water-cooled. When the ore is melted it loses its magnetism and drops out of the magnetic zone, new material being substituted."

A long discussion followed the reading of the paper, the consensus of opinion being that there is at present no probability of the electric furnace superseding the blast furnace in the reduction of iron ores.

The paper entitled "Voltaic Cells with Fused Electrolytes," by Dr. Eugene A. Dyrnes, gave the results of a great many measurements of the E.M.F. of cells, in which the electrolyte was fused sodium hydroxide.

Prof. Hutton's paper on "The Fusion of Quartz in the Electric Furnace," described a process for making quartz fibres and small tubes for scientific purposes.

Prof. H. S. Carhart, in his paper, the "Thermo-electric Theory of Concentration Cells," says that "in Nernst's formula, the E.M.F. of a concentration cell is proportional to the absolute temperature, which suggests a thermal origin. The same conclusion is reached from Helmholtz's formula for the E.M.F. of a voltaic cell; for a concentration cell the first term of this formula is zero, corresponding to the formation heat of the chemical processes, and the E.M.F. is directly equal to the absolute E.M.F. multiplied by the temperature coefficient of the E.M.F. A concentration cell is a device for converting heat into electrical energy."

Mr. Carl Hering, in a paper entitled "An Apparent Electro-Chemical Paradox," describes a curious experiment which he and Mr. Reed made some years ago, in which water was decomposed in visible quantities at voltages far below the theoretical (about 1·45), even as low as about 0·3 volt. This seems to contradict the law of the conservation of energy, as these gases, in recombining, could generate more than this amount of energy, and it would therefore be a perpetual motion, which is impossible. The experiment consisted in electrolysing acidulated water in a strong N-shaped glass tube which was sealed at both ends and provided with a bend containing mercury, which enabled the mechanical pressures to be read off. The results are shown in a curve. The pressures reached about 23 atmospheres when the tube exploded. The voltage at the terminals when a constant current passed, diminished rapidly and very decidedly to about 0·3 volt at about 16 atmospheres, and then remained practically constant. Allowing for the loss due to resistance, the actual voltage of decomposition was even much lower, nearly zero. There was visible gassing during the whole test, showing that water was really being decomposed; the increasing pressures also showed this.

No researches were made to find the correct explanation of this curious result; the intention of the paper being merely to describe the experiment. A possible explanation is, however, suggested, showing how the results need not be inconsistent with Faraday's law, or the law of the conservation of energy. It is based on the assumption that some of the gases probably passed mechanically to the opposite electrode, which they could easily do in suspension, as the electrodes were very close together. These were consumed as depolarisers, so that only a fraction of the theoretical amount of gas was really liberated. This deplorarisation lowered the voltage. A calculation based on this reduced amount of gas which was actually liberated, on the actual current which passed, and on the energy which must be accounted for to conform with theory would also show that the required voltage need be only very low, the lower, the greater the amount of depolarisation.

The paper concludes with a suggestion of an experiment in which water is electrolysed in a strong, sealed vessel which is completely filled so as to leave no room for the gases. Some curious results may then be expected.

Mr. P. G. Salom's paper on "Additional Notes on Lead Reduction," was not read as it was not thought advisable on account of certain patents now under consideration. It will be presented at the next meeting of the society.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,515. "Improvements in dynamo-electric machines." B. G. Lamme. (Date applied for under Patent Acts, 1901, September 24th, 1901, being date of application in the United States. September 22nd. (Complete.)

20,624. "Improvements in alternating current generators." E. Gaskell and A. J. Hedgcock. September 22nd.

20,645. "Improved means for regulating the consumption of current by electromotors." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien Gesellschaft, Germany.) September 22nd.

20,647. "Improved construction of electrical transformers, choking coils and the like." Siemens Bros. & Co. (Siemens Aktien Gesellschaft, Germany.) September 22nd.

20,648. "Improvements in telephonic installations having several branch stations communicating by a common line wire with a central exchange." A. Goldworm and A. Horowitz. September 22nd.

20,655. "Improvements in and connected with the purifying or other treatment of water and other liquids or fluids by electrolysis." W. B. Hardy. (C. F. Warner, United States.) September 22nd.

20,656. "Improvements in or relating to switches and connections for testing electric current circuits." G. L. Addenbrooke and L. Robinson & Co. September 22nd.

20,680. "Apparatus for automatically detecting and showing the existence of foul gas in mines and like places and electrically indicating and recording the presence of such gas to those in charge of the mine or the like works." J. Hylard. September 22nd.

20,682. "Improvements in and connected with apparatus for printing telegraphs." W. L. Wise. (C. L. Buckingham, United States.) September 22nd. (Complete.)

20,683. "Improvements in page printing telegraphs." W. L. Wise. (C. L. Buckingham, United States.) September 22nd. (Complete.)

20,684. "Improvements in perforating machines for preparing telegraphic messages for automatic transmission." W. L. Wise. (C. L. Buckingham, United States.) September 22nd. (Complete.)

20,700. "An improved electrical fire alarm." W. Timms. September 23rd.

20,755. "Electrical controlling apparatus for electrical motors and the like." O. Imray. (Sprague Electric Company, United States.) September 23rd. (Complete.)

20,794. "A 'wire finder' for the overhead wire on electric tramways." T. Turner. September 24th.

20,803. "An improved terminal for electric connections." G. E. Carr. September 24th.

20,805. "Improvements relating to prepayment instruments for use with telephones and other electrical instruments." H. J. Dawes. September 24th.

20,863. "Improvements in means or apparatus for attaching electric sconces and the like to walls, ceilings, and other places." A. van Houdonk. September 24th.

20,866. "Time limit device for electrical circuit-breakers." B. Thomas and E. Thomas. September 25th.

20,871. "Improvements in or relating to electric storage batteries and the like." M. Sutherland and E. Marcuson. September 25th.

20,887. "Improvements in and connected with electric railways and signalling apparatus therefor." R. J. Sheehy. September 25th. (Complete.)

20,923. "Improvements in means for adjusting the height of suspended electric lamps." A. Huber, Jun. Dated September 25th. (Complete.)

20,931. "Improvements in automatic electric fire alarms and generally applicable to heat operated signalling and controlling devices." R. F. S. Venner. September 25th.

20,939. "Incandescent glow lamp." T. Quartermaine and H. Knight. September 26th.

20,940. "Improvements in dynamo-electric machines." J. Atkinson.

21,005. "Improvements in and connected with the purifying or other treatment of water and other liquids or fluids by electrolysis." W. B. Hardy. September 26th.

21,019. "Improvements in connection with submarine or other vessels, torpedoes, and the like, for controlling and operating them by electricity." L. Wilson. September 26th. (Complete.)

21,021. "Improvements in or connected with the poles or electrodes of electrolysic apparatus and the like." G. J. Atkins. September 26th.

21,047. "Improvements in and in appliances for use in connection with certain drums for holding electric cables." H. Sutcliffe. September 27th.

21,075. "An improvement in flexible metallic tubing for armouring insulated electrical conductors." W. H. K. Bowley. September 27th.

21,077. "An improved inflexible metallic tubing for armouring electrical conductors." W. H. K. Bowley. September 27th.

21,090. "Improvements in perforators more particularly for use with automatic telegraph transmitters." J. Gell. September 27th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

13,867. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (*L. W. Rice, U.S.A.*) Dated August 3rd, 1900. Relates to systems in which an alternating current generator producing a given number of phases may be connected to leads, &c., carrying currents of a different number of phases. The arrangements are particularly applicable for use in converting into direct currents. 11 claims.

13,868. "Improvements in systems of electric motor control." British Thomson-Houston Co. (*A. G. Davis, U.S.A.*) Dated August 3rd, 1900. Relates to means for simultaneously controlling a number of motors situated at several different points, as in a train-control system. The controller for each motor equipment is of the class in which the movable contacts are all mounted on a common supporting cylinder by the rotation of which the necessary changes of connection of the motors and the resistances are effected. The simultaneous step-by-step movements of the several motor controllers are determined by the master controller. 12 claims.

13,869. "Improvements in insulated electric conductors." British Thomson-Houston Co. (*W. le R. Emmet.*) Dated August 3rd, 1900. Conductors, whether single or multiple, are covered with several layers of paper spirals saturated with impervious insulating composition, such as boiled oil and resin. The paper may be saturated before or after winding on the conductor, each layer being thoroughly coated and dried before another is applied. The material may be used either as a solution or melted. An external armouring is afterwards added. 8 claims.

13,971. "Improvements in rectifiers for alternating electric currents." British Thomson Company. (*E. Thomson, U.S.A.*) Dated August 3rd, 1900. Relates to means for preventing sparking in rectifying alternating currents, and for minimising the effect of "hunting" in the synchronous motor employed. Instead of adjusting the position of the brushes, the phase relationship of the alternating currents is varied to produce the same effect, and the motor is connected to the commutator shaft by a flexible connection. 11 claims.

13,972. "Improvements in systems of electrical distribution." British Thomson-Houston Company. (*H. D. Lunt, U.S.A.*) Dated August 3rd, 1900. Relates to alternating current distribution, and especially to a system in which the alternating current is transformed and then converted by a six-phase converter into a direct current for distribution on the three-wire system. The neutral wire of this system is connected to a neutral point in the alternating-current system. 17 claims.

13,973. "Improvements in insulated electric conductors." British Thomson-Houston. (*W. le R. Emmet, U.S.A.*) Dated August 3rd, 1900. Conductors are coated with layers of fabric saturated with a solution or melted mixture of oxydisable vegetable oil and rosin, the layers being allowed to harden between each successive application. A section of such a conductor is described. The coils of wire forming the armature of a dynamo or motor may be similarly insulated. In some cases the fabric may be omitted, the several layers of oxidised, &c., forming the insulation. 12 claims.

13,974. "Improvements in systems for controlling electric motors." British Thomson-Houston Company. (*C. E. Barry.*) Dated August 3rd, 1900. Relates to control systems in which the motor-controllers are actuated from a master controller situated at a safe distance; for example, at one end of a train, and more particularly to those in which the contacts of each motor-controller are actuated by a number of electro-magnets connected with the master controller by a series of conductors running along the train. 10 claims.